VOL. 6 NO. 4
February 28, 1981

Energy Research Abstracts

ABSTRACTS 4419-5643

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications which are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following: programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $3.00, foreign $3.75 per copy; annual cumulative index, domestic $4.00, foreign $5.00 per copy. The annual subscription price is $38.00 for domestic subscribers and $47.50 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. Indexes are cumulated semiannually and annually. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues including a semiannual index and an annual index is $184.00 for domestic subscribers and $230.00 for foreign subscribers. The semiannual and annual indexes will also be available separately to subscribers. The cost for the semiannual index is $18.00 (domestic) or $22.50 (foreign); the annual index is $33.00 (domestic) or $41.25 (foreign). A single issue costs $5.55 (domestic) or $6.95 (foreign).

The following publications are available to the public on a subscription basis from the National Technical Information Service (NTIS), Springfield, Virginia 22161. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $45.00 for domestic subscribers and $90.00 for subscribers outside the North American Continent. A single issue is $6.00 (domestic) and $12.00 (outside the North American Continent).

Current Energy Patents (CEP)

A monthly publication providing abstracting and indexing coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization. Available as PB81-902800.

Energy Conservation Update (ECU)

A monthly abstract journal devoted to current information on energy conservation in buildings, transportation and propulsion, and industry; waste processing plants and equipment; energy storage; energy conversion; advanced automotive systems; combustion systems; power cycles; synthetic fuels; and power transmission. Available as PB81-914800.

Energy and the Environment (EAE)

A monthly abstract journal devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment. Available as PB81-914900.

Fossil Energy Update (FEU)

A monthly abstract journal devoted to information on the processing and use of fossil fuels. Available as PB81-914600.

Fusion Energy Update (CFU)

A monthly abstract journal devoted to information on controlled thermonuclear research. Available as PB81-915300.

Geothermal Energy Update (GEU)

A monthly abstract journal devoted to information on the exploration and development of geothermal resources. Available as PB81-914700.

Solar Energy Update (SEU)

A monthly abstract journal devoted to information on the utilization of solar, tidal, and wind energy. Available as PB81-914500.

Synthetic Fuels Update (SFU)

A monthly abstract journal devoted to information on coal gasification; coal liquefaction; other coal processing; biomass conversion to fuel; shale oil and tar sand bitumen production; hydrogen fuels; other hydrocarbon fuels; alcohol fuels; and inorganic hydrogen compound fuels. Available as PB81-902700.

INTERNATIONAL ENERGY PUBLICATIONS

Atomindex (Published in cooperation with the Technical Information Center by the International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria)

A semimonthly abstract journal devoted to information on nuclear science and technology. Through an exchange agreement, IAEA/INIS provides all non-U. S. nuclear information of *Atomindex* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. nuclear information to IAEA/INIS for inclusion in *Atomindex*. *Atomindex* is available by subscription from UNIPUB, P.O. Box 433, Murray Hill Station, New York, NY 10016. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $150.

Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

A monthly abstract journal devoted to information on coal. Through an exchange agreement, IEA Coal Research provides all non-U. S. coal information of *Coal Abstracts* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. coal information to IEA Coal Research for inclusion in *Coal Abstracts*. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Technical Information Center, as the national information center for the Department of Energy, manages, publishes, and disseminates scientific, technical, and practical energy information acquired from worldwide sources. It builds and maintains energy information data bases used to prepare abstracting journals, bibliographies, and literature searches. The data bases are also searchable via the Department's on-line retrieval system, DOE/RECON. This information is provided to DOE program offices and contractors; scientists; engineers; educational, commercial, and industrial communities; and the general public. The Technical Information Center conducts an active announcement and marketing program. It establishes policy and administers control of an inventory and registry for DOE publications. The Center also develops and evaluates new and effective information systems and services as required by scientific and technical management within the Department of Energy.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, conservation, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Federal, state, and municipal agencies concerned with energy development, conservation, and usage may obtain *ERA* free of charge. Inquiries should be directed to the Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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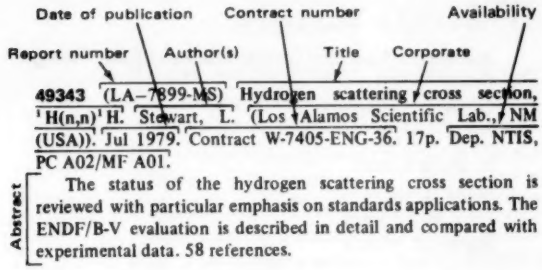
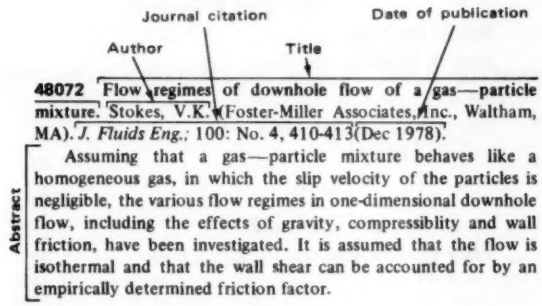
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

•Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. **(Los Alamos Scientific Lab., NM (USA)).** Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

HYDROGEN 1 TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, ¹H(n,n)¹H (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
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HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
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W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	4:49343	Dep. NTIS, PC A02/MF A01
LA-tr-		
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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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4419 (BNL—28577) Flash pyrolysis and hydropyrolysis of coal. Steinberg, M.; Bhatt, B. (Brookhaven National Lab., Upton, NY (USA)). Oct 1980. Contract AC02-76CH00016. 22p. (CONF-8010126—1). NTIS, PC A02/MF A01.

From Specialists workshop on fast pyrolysis of biomass; Copper Mountain, CO, USA (20 Oct 1980).

A brief summary of the major findings of pyrolysis and hydropyrolysis are as follows: Rapid pyrolysis of coal usually produces larger yields of volatile matter including liquid and gaseous hydrocarbons than slow pyrolysis. Rapid pyrolysis in vacuum or with an inert atmosphere yields lower conversions of coal to liquid and gaseous hydrocarbons than hydropyrolysis in a hydrogen atmosphere. Pyrolysis in a higher pressure inert atmosphere tends to decrease overall yields. Rapid pyrolysis in an inert atmosphere produces larger amounts of heavier liquids and tars than hydropyrolysis. Hydropyrolysis at higher hydrogen pressures produces higher overall yields. Rapid pyrolysis at higher temperatures tends to decrease yields and produce lower molecular weight species. Rapid hydropyrolysis at higher temperatures produces more gaseous hydrocarbons and lower liquid yields. There are optimum residence times for maximizing either liquid or gaseous yields. Pyrolysis in an inert atmosphere at longer residence times tend to increase conversions but then becomes constant after devolatilization is complete. Heating rate is a function of the method of heating. Entrained gas heating with hydrogen produces the highest heating rates and the highest yields. Lower rank coals tend to be more reactive and produce higher yields of gaseous and liquid hydrocarbons than higher rank coals. From a process economics point of view, pyrolysis in an inert atmosphere requires the need for a consumer of residual char, and an upgrading of heavier liquids. In a flash hydropyrolysis process, the char can be used to produce hydrogen consumed in the process. A considerable fraction of the process cost is involved in production, recovery and recycle of hydrogen.

4420 Attrition rates of relatively coarse solid particles in various types of fluidized beds. Kono, H. Chicago, IL; Institute of Gas Technology (Jul 1980). 12p. (NP—25189).

Attrition rates of coarse solid particles in a fluidized bed are considerably larger than those of fine particles in a fluid bed. The attrition rate of Mullite particles, selected as model particles, were systematically measured while changing operational and geometrical parameters and scale factors. The results are summarized as empirical equations, and are discussed to clarify the influence of the changes on attrition rates.

4421 (CONF-801079—) Materials for coal conversion and utilization. (National Bureau of Standards, Washington, DC (USA)). 1980. 400p. NTIS, PC A17/MF A01.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The Fifth Annual Conference on Materials for Coal Conversion and Utilization was held October 7-9, 1980, at the National Bureau of Standards, Gaithersburg, Maryland. Sixty-six papers have been entered individually into ERA and EDB; two had been entered previously from other sources. (LTN)

4422 (CONF-801079—, pp I.1-I.5) Materials research for the clean utilization of coal. Task 2: materials performance and properties data. Ondik, H.M.; Dobbyn, R.C. (National Bureau of Standards, Washington, DC). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

A computerized data base of approximately 500 reported failures has been established and is continually being updated, refined and increased as additional failure reports are received. Separate information items addressing the same failure are collated when possible. In addition, direct contact with operating personnel at the various process locations and failure analysis laboratory staff has enhanced both the quality and the flow of information as well as assisting plant operators in problem solving. The coal gasification materials properties and performance data are being combined with information from the Failure Information Data Base to be contained in a looseleaf format book, Construction Materials For Coal Gasification-Performance and Properties Data.

4423 (CONF-801079—, pp I.6-I.10) Development and application of nondestructive test methods for coal conversion and utilization systems. Ellingson, W.A.; Youngdahl, C.A.; Caines, M.J.; Roberts, R.R. (Argonne National Lab., IL). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objectives of this research program are to: (1) identify those areas in coal conversion and utilization processes where development and application of advanced nondestructive evaluation (NDE) methods and procedures would have identifiable payoff in terms of improved reliability and safety, (2) develop those necessary NDE methods and procedures through comprehensive analytical, laboratory, and field programs, and (3) provide NDE support not available on a conventional commercial basis to DOE-funded test facilities.

4424 (CONF-801079—, pp I.11-I.15) Failure prevention and analysis in coal liquefaction systems. Baylor, V.B.; Keiser, J.R.; Swindeman, R.W. (Oak Ridge National Lab., TN). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

This task is aimed at improving materials performance and operating lives in large coal liquefaction plants through a careful metallurgical examination of components and surveillance coupons taken from pilot plants and process demonstration units. Pilot plant and process demonstration unit materials experience for liquefaction and other fossil energy systems can provide some of the most important and practical guidance for needed research and development for later plants. Oak Ridge National Laboratory (ORNL) staff members have examined failed or used components and surveillance coupons from operating plants. The objectives are to: 1. obtain materials-related data and experience that can assist in the selection of materials for and in the design, construction, and operation of later plants; 2. provide assistance to plant operators by providing failure analyses; and a record for incorporation into the Central Failure Analysis Data Bank operated by NBS.

4425 (CONF-801079—, pp I.16-I.20) Component performance and failure analysis. Diercks, D.R. (Argonne National Lab., IL). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objectives of this program are: (1) to provide failure analysis services and evaluate the performance of coal conversion plant components that have failed or have otherwise been removed from service, (2) to make recommendations concerning materials

selection, component design, or process conditions so that similar failures can be avoided, and (3) to disseminate this information for subsequent use in the design and operation of related pilot and demonstration plants. The program is designed to provide timely failure analysis services to coal conversion pilot and demonstration plants and component test facilities. In-depth analyses are cataloged, and the findings and recommendations resulting from these analyses are relayed to the pilot plants, the National Bureau of Standards Failure Information Center, and other laboratories. The analyses of a number of components from pilot plants and test facilities which have been completed in the past year are described.

4426 (CONF-801079—, pp II.1-II.9) **Program on materials for the gasification of coal.** Black, H.L. (Metal Properties Council, Inc., New York, NY). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of this program is to test materials of construction, both metals and ceramics, to evaluate their usefulness under anticipated service conditions in plants for the gasification of coal. Testing includes screening, followed by determination of those properties essential to engineering design. These include corrosion and erosion resistance as well as mechanical and physical properties under service conditions. Gasification processes are alike in that all require the containment, under pressure, of extremely corrosive gas mixtures at elevated temperatures. These conditions exceed those imposed in commercial practice on metals heretofore. This program has been designed to determine which materials might be successful in such service. Following this, the program is directed to generating and assembling necessary engineering data on the successful materials. It was found convenient to divide the program into phases, five of which are now active. Significant results are described briefly.

4427 (CONF-801079—, pp II.10-II.17) **Evaluation of advanced materials for use in letdown valves for coal liquefaction service.** Clauer, A.H.; Wright, I.G. (Battelle Columbus Labs., OH). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of the program is to conduct laboratory slurry erosion experiments with limited supporting pilot plant trials to: generate data on candidate valve materials under varied wear conditions, which will be useful to valve and process designers in materials selection and valve design; determine a suitable substitute erodant and liquid carrier combination for use in standardizing laboratory materials evaluation and screening tests; confirm the utility of a laboratory wear test in evaluating materials for actual valve service; and develop an improved understanding of mateials behavior in slurry erosion. This program is essentially an extension of work initiated by EPRI in support of the SRC II (Wilsonville) process.

4428 (CONF-801079—, pp II.18-II.22) **Design of materials for use under erosion/corrosion conditions at high temperature in coal gasification and coal combustion systems.** Wright, I.G.; Nagarajan, V. (Battelle Columbus Labs., OH). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objectives of this work are to determine the effectiveness of various controllable variables on the erosion-corrosion of a series of metallic alloys, so that guidelines for improved alloy design and effective materials selection or system modification can be developed. The modes of degradation of ten alloys, possessing properties considered desirable for resistance to a combination of high-temperature corrosion and erosion, were evaluted in three corrosive environments, after which an erosive component was added, and changes in behavior determined. The corrosive environments were dynamic oxidation, simulated flue gas and a simulated coal gasifier atmosphere. Results of these studies indicated that distinct regimes can be distinguished where erosion plays little part (deposition occurs), or where erosion plays a dominant part in the degradation. In the corrosion-dominated regime (low-velocity flue gas, low or high velocity gasifier environment), all the state-of-the-art alloys corroded, some very rapidly. However, several promising directions for alloy development towards improved environmental resistance were apparent. In the erosion-dominated regime (high velocity flue gas), where all the alloys were found to erode, no obvious correlation was found between microstructure, hot hardness, or hot strength and erosion behavior except that the alloys with the slowest erosion rates were weak/soft and apparently retained protective oxide scales to various extents. Current goals of this program are to more closely define the threshold conditions for the erosion-dominated regime, and to determine the validity of the concept of a kinetic energy or momentum threshold criterion.

4429 (CONF-801079—, pp II.23-II.28) **Correlation of the high-temperature corrosion behavior of structural alloys with the components of coal conversion environments.** Wright, I.G. (Battelle Columbus Labs., OH). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

This program was designed to characterize and describe the corrosion behavior of four structural alloys in a range of coal conversion-type environments in a way that would allow statistical correlations to be developed between corrosion behavior/rate, process variables such as gas temperature, total pressure, composition, and alloy variables such as nickel and chromium contents. It was anticipated that the results would allow the prediction of trends in corrosion behavior with changes in process conditions for alloys of the general Fe-Ni-Cr type. The analysis should also establish the relative importance of variables such as total pressure, and so provide information on the basic requirements for accelerated corrosion testing in these complex environments. A series of four alloys was used to provide a desired range of chromium and nickel contents. These were Inconel 671; AISI 310; Incoloy 800; and USS 18-18-2. The environmental variables covered were temperature (1382, 1600, 1800 F), pressure (500, 1000, 1500 psig), and sulfur partial pressure. The mixtures were such that the oxygen partial pressure was essentially constant under the different conditions. The results are described briefly.

4430 (CONF-801079—, pp II.29-II.33) **Corrosion and mechanical behavior of materials for application in coal conversion and utilization.** Natesan, K. (Argonne National Lab., IL). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

During the past year, a state-of-the-art review document on the corrosion and mechanical behavior of materials at elevated temperatures in coal-gasification environments has been prepared. The information developed over the last five years clearly shows sulfidation to be the major mode of material degradation in these environments. In the review, the corrosion behavior of structural materials in complex gas environments is examined to evaluate the interrelationships between gas chemistry, alloy chemistry, temperature, and pressure. Thermodynamic aspects of high-temperature corrosion processes that pertain to coal conversion are discussed, and kinetic data are used to compare the behavior of different commerical materials of interest. The influence of complex gas environments on mechanical properties, such as tensile, stress rupture, and impact strength of selected alloys are presented. The data have been analyzed, wherever possible, to examine the role of environment in the property variation. Deposit-induced hot corrosion behavior of heat exchanger and gas turbine materials exposed to multicomponent gas environments is of considerable interest in advanced energy systems that utilize fossil fuels. For this purpose, characterization of environments in low-Btu gasification and direct-combustion processes and evaluation of materials in complex gas mixtures that simulate normal operating conditions and off-normal excursion situations are in progress.

4431 (CONF-801079—, pp II.34-II.38) **Erosion studies in coal conversion systems.** Park, J.Y. (Argonne National Lab., IL). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The erosion-testing apparatus was modified and refurbised. The apparatus consists of a motor-driven rotating slinger arm and a mechanism in a sealed test chamber, which permits erosion-corrosion testing on 40 specimens simultaneously at elevated temperatures and in controlled atmospheres. Room temperature erosion calibration tests were performed on 1015 carbon steel, Type

304 SS, Incoloy 800, Type 310 SS, and Stellite 6B using 150 μm Al_2O_3 particles with an impact velocity of 22 m/s and impact angles 6-81° in an air environment. The erosion rate (mass loss/mass impacted) was calculated from weight loss, and results are given. The rate is in the range of 0.03 to 0.09 mg/g, which is about 7 times lower than that obtained in earlier tests at 70 m/s using 50 μm Al_2O_3. However, the variation is consistent with the expected dependence of erosion rate on velocity. Corrosion calibration tests were performed on Stellite 6B, Type 304 SS, 1015 Carbon Steel and Incoloy 800 in a simulated gasifier atmosphere.

4432 (CONF-801079—, pp II.39-II.41) **Weld overlaying for corrosion resistance in coal gasification atmospheres.** Sadowski, E.P. (INCO Research and Development Center, Inc., Suffern, NY). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The primary objective of this program was the development and evaluation of weld deposited overlays to provide corrosion resistance in coal gasification atmospheres. This work was aimed at providing corrosion resistance in areas where corrosion conditions are expected to be most severe such as gasifier internals. A secondary objective was to establish the effects of exposure to a coal gasification atmosphere on the mechanical properties of weldments as a measure of metallurgical stability.

4433 (CONF-801079—, pp II.42-II.45) **Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres.** Douglass, D.L. (Univ. of California, Los Angeles). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Six alloys, 310 stainless steel, Hastelloy X, Inconel 671, Incoloy 800, Haynes 188, and Fe-15Cr-4A1-1Y, were exposed to two chars at 1600 and 1800°F. The chars, FMC and Husky, contained 2.7 and 0.9% sulfur, respectively. The work involved the study of various parameters such as char size, cover gas, char quantity, char-replenishment period, the effect of preoxidation, etc. Corrosion kinetics were determined by weight gain measurements when feasible. Identification and characterization of the reaction products were performed by x-ray diffraction, dispersive x-ray energy analysis, and electron microprobe analysis. Corrosion in char is strictly a sulfidation reaction if the char does not become depleted in sulfur. The reaction produces a massive external sulfide scale consisting of chromium sulfide on nickel-base alloys. Extensive internal sulfidation occurred in both the substrate grain boundaries and grains to form primarily chromium sulfide. The char contained volatile sulfur which formed H_2S in the gas as well as pyritic sulfur (about 0.6%) which did not enter into the reactions.

4434 (CONF-801079—, pp II.46-II.48) **Thermal stability of ferritic alloys for fossil fuel processing systems.** Polonis, D.H. (Univ. of Washington, Seattle). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

This program is examining the influence of ternary alloy element additions on the metallurgical stability of low chromium ferritic steels for application in fossil fuel processing systems. Other workers have shown that small additions of aluminum to Fe-Cr steels have beneficial effects on the resistance to high temperature oxidation and sulfidation. The susceptibility of Fe-Cr binary alloys to 475°C embrittlement has been well documented in the literature, and this reaction imposes serious limitations in using ferritic stainless steels at temperatures in the range 400 to 600°C for prolonged periods of time. Metallurgical stability studies are being conducted on two binary Fe-Cr alloys and four ternary Fe-Cr-Al alloys; the specific weight percentage compositions are Fe-15Cr, Fe-18Cr, Fe-15-Cr-4A1, Fe-15Cr-6A1, Fe-18Cr-3A1, and Fe-18Cr-5A1. The binary Fe-Cr alloys are included in the present study in order to provide a comparison basis for evaluating the effects of aluminum additions on the metallurgical stability of the ferritic alloys. Another aspect of the present program has included stability studies on several quaternary compositions, Fe-Cr-A1-Hf, and several commercial ferritic stainless steels containing both chromium and aluminum as major alloying elements.

4435 (CONF-801079—, pp II.61-II.63) **Materials for in situ processing systems.** Loop, R.B. (EG & G Idaho, Inc., Idaho Falls). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Specimens of a number of candidate structural alloys were exposed to the direct product gas stream during three different in situ coal gasification experiments at two sites (Hoe Creek III and Hanna IV, phases I and II). The three operating conditions differed in gas temperature, velocity, composition, and particulate content. The deposit on the Hanna IV (phase I) specimens had a fairly high concentration of sulfur (~ 8%) while those from Hanna IV (phase II) and Hoe Creek III had very low sulfur concentrations (0.014%) and 0.31%, respectively. Mean penetration rates expressed in mils per year were calculated from the weight loss data.

4436 (CONF-801079—, pp II.64-II.66) **Development of coatings for corrosion/erosion protection of internal components for coal gasification vessels.** Stevens, W.G. (Solar Turbines International, San Diego, CA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Coal gasification processes (including HYGAS, COGAS, Agglomeratic Ash Gasifier, etc.) require the use of particulate solid handling equipment and instrument probes wholly within the hot, high-pressure enclosure (gasifier). This environment is quite aggressive and corrosion of the alloys (304 and 310 stainless steels and Incoloy 800) from which these internal components will be fabricated has been predicted to proceed at rates up to 0.5 mm/year. Overlay coatings containing significant amounts of nickel or cobalt and chromium and aluminum have been suggested as mitigants for the corrosive attack of these gasifier environments. Although physical vapor deposition (PVD) and cathode and triode sputtering have been employed to coat the surfaces of gas turbine parts, subject to accelerated oxidation and hot corrosion, with these Ni/CoCrA1Y layers, the physical size of many of the internal components of coal gasifiers dictate that alternate methods must be developed to apply these corrosion resistant coatings. Furthermore, the developed technique(s) should be applicable to on-site coating for both initial assembly and field repair of these internal assembly and field repair of these internal components of coal gasifiers. A major goal of the present program was to develop plasma spray deposition techniques for coating the surfaces of the internal components of coal gasifiers with a multi-layer Ni/CoCrA1Y(X) coating. Another major goal was the development of a multi-layered plasma sprayed overlay coating process system to arrest the corrosion attack by the coal gasifier environment.

4437 (CONF-801079—, pp III.1-III.4) **Design properties of steels for coal conversion vessels.** McCabe, D.E.; Landes, J.D. (Westinghouse R & D Center, Pittsburgh, PA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of this project was to evaluate the properties of 2 1/4Cr-1Mo in metallurgical conditions simulative of the heavy wall reactor vessels anticipated in liquefaction and gasification operations. The approach taken was to apply fracture mechanics type methods of test to evaluate the material's propensity for environmentally assisted crack growth and fracture toughness degradation when exposed to high temperature - aggressive gases at high pressures. The metallurgical conditions evaluted were A387 and A542 base metal, weld metal, and heat affected zone. There also was a simulation of type 347 stainless steel overlay material on A387 substrate material. Cracked specimens of the standard compact geometry were tested under a rising load technique to identify the onset of environmentally assisted crack growth.

4438 (CONF-801079—, pp III.5-III.11) **Alloy evaluation for fossil fuel process plants (liquefaction).** Scott, T.E. (Ames Lab., Iowa). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of this investigation is to evaluate the mechanical property integrity of liquefaction process plant dissolver vessel materials, especially 2-1/4Cr-1 Mo steel. Bainitic 2-1/4Cr-1 Mo steel samples are exposed to the environment created by a

heated (R.T. to 800°F) mixture of powdered coal and coal-derived solvent pressurized (2000 and 4000 psig) and hydrogen. Integrity of the mechanical properties during or after the exposures is evaluated by comparison with identical samples exposed under identical temperature and pressure conditions using argon gas rather than the coal slurry-hydrogen environment. Sample types include smooth-bar and notched-bar tensile specimens, corrosion coupons, and compact tension fracture mechanics specimens. In addition to in-situ low cycle fatigue tests of compact tension samples, smooth and notched-bar samples are exposed with and without applied stress and some compact tension samples are bolt-loaded during exposure.

4439 (CONF-801079—, pp III.33-III.39) **Evaluation of the fracture toughness of candidate steels for pressure vessels for coal conversion systems.** Canonico, D.A. (Oak Ridge National Lab., TN). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

This program is directed toward the characterization of the fracture toughness of the steels that are candidates for the construction of the extremely large pressure vessels that have been proposed for second generation coal conversion systems. Or goal is to determine the effect of operating environments, particularly hydrogen, on their properties. The program will characterize the tensile and toughness properties of materials that may be employed in the fabrication of large-thick-walled pressure vessels. The most likely candidate for these vessels is 2 1/4 Cr-1 Mo steel; a steel represented by ASME and ASTM specifications SA-387 grade 22 and A-542. The properties of this steel and other possible candidates such as SA-516 and SA-204 grade B will be determined at various depth locations through their plate thicknesses. Both thickwalled, 150- to 406-mm (6- to 16-in.) commercially obtained plates (and forgings) and material that is cooled from the austenitizing temperature to produce microstructure simulating these thick section sizes will be examined. Predictions of hydrogen attack of these materials will be made based on thermodynamic calculations involving the carbon activity in the steel. These predictions will be tested through experimental studies involving the exposure of the candidate steels to high pressure-high temperature hydrogen environments. The environmental studies will involve materials in metallurgical conditions that represent the various processing sequences possible in a fabricated component.

4440 (CONF-801079—, pp III.44-III.47) **Biaxial testing of candidate coal gasifier alloys.** Horton, R.M. (EG & G Idaho, Inc., ID). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The goal of this program is to measure the biaxial stress rupture strength and ductility of four selected candidate coal gasifier alloys in four atmospheres intended to simulate a coal gasifier atmosphere (CGA). Baseline tests in air will show whether exposure to these simulated gasifier atmospheres has an adverse effect on these mechanical properties. The alloys being tested are type 310 stainless steel (310 SS); Incoloy 800H, both bare and Alonized; Haynes 188; and IN-657. The outside of the thin-walled tubular specimen is exposed to either air or CGA at 6.9 MPa (1000 psi) and the inside of the tube pressurized with argon to produce rupture in approximately 100 hours. The composition of the four CGAs used is given. Test temperature are generally 992, 1089, 1172, and 1255 K (1200, 1500, 1650, and 1800°F). The most noteworthy results are: 1. The biaxial stress rupture tests show the same trends and approximately the same values as uniaxial data obtained from the literature for each alloy tested. 2. Exposure to the four CGAs did not reduce the biaxial stress rupture strength or life below that in air at temperatures up to 1089°K (1500°F). 3. At 1255 K (1800°F) the stress rupture strength and life of all specimens tested in the CGA system were below those obtained in atmospheric pressure air. There are indications that this is not due to the CGA but results from a creep-fatigue interaction with the fatigue being inherent in this CGA test system design. 4. The biaxial strain at failure was small, typically only a few percent, for all mateials tested and was substantially lower than is found in uniaxial tests. Only for H-188 was the failure strain in the CGAs generally lower than that in air.

4441 (CONF-801079—, pp III.93-III.100) **Program on corrosion of metals in coal liquefaction processes.** Lyle, F.F. Jr.; Arey, R.; Adams, L.M. (Metal Properties Council, Inc., New York, NY). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objectives of this program are to: (1) determine the general susceptibility of carbon steels, stainless steels, and nickel-base alloys to corrosion in coal liquids; (2) identify and measure concentrations of suspected corrosive species in coal liquids before and after corrosion tests; (3) determine the effect of temperature on corrosion of metals and on the stability of corrosive species in coal liquids; (4) relate extent, type of corrosion, and corrosion mechanism(s) to corrosive species present in coal liquids; and (5) provide background data for the interpretation of results of in-situ corrosion tests and failures in liquefaction plants. Coal liquids are to be collected from the six plants listed. Five alloys are to be exposed in the corrosion-test portion of the program. These alloys represent materials commonly used in the chemical process industries, and include materials being exposed in pilot-plant corrosion test programs or currently in use in process components. The alloys are: 1) Carbon steel, 2) 5Cr-1/2Mo Steel, 3) Type 410 Stainless Steel, 4) Type 316 Stainless Steel, and 5) Hastelloy C-276.

4442 (CONF-801079—, pp III.101-III.105) **Coal liquefaction alloy test program.** Levy, A.V. (Univ. of California, Berkeley). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The object of this program is to determine the erosion/corrosion behavior of materials used in the flow passages of liquid slurries under conditions representative of those in coal liquefaction systems. From the understanding gained from testing a number of different materials over a range of controlled operating conditions within and beyond those of currently acceptable practice, slurry flow operating parameter guidelines and improved performance, materials selection and design criteria will be developed. The information from this program will be structured so that it is directly usable by coal liquefaction system designers. Among the materials that are being tested are A53 mild steel, 1075 carbon steel, 2 1/4 Cr 1 Mo alloy steel, types 304, 316, 310, 410 SS, and Ni-HARD cast iron. The slurries consist of -200 mesh coal in kerosene, creosote oil and SRC process solvent at solids loadings of 20 to 50 wt% coal. Slurry test velocities range from 10 to 40 fps and test temperatures from RT to 200°C.

4443 (CONF-801079—, pp III.106-III.108) **Design of low alloy steels for thick walled pressure vessels.** Parker, E.R.; Zackay, V.F. (Univ. of California, Berkeley). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of this program is to modify existing commercial low alloy steels or to develop new alloys which can be field fabricated into large diameter, thick walled pressure vessels for coal gasification and liquefaction systems. Alloy modifications of 2.25Cr-1Mo steel and Mn-Mo-Ni steel (SA533B), which have improved strength and toughness properties in the quarter thickness locations of 12" to 16" thick sections have been developed. The most promising modifications (e.g. minor additions of Ni, Mn to 2.25Cr-1Mo) are being evaluated for their suitability in coal liquefaction environments and the following important areas of study have been defined: Hydrogen attack susceptibility, resistance to temper embrittlement, weldability, fracture toughness, and creep behavior. Comparison between alloy modification and base metal properties will be made. Microstructural examination has shown that the effect of minor additions of Ni, Mn to 2.25Cr-1Mo steel was to eliminate polygonal ferrite formation in quarter thickness locations of 12" to 16" plates and to alter the morphology of the continuously cooled bainite from predominantly upper bainite to lower bainite. These elements also changed the tempering response of 2.25Cr-1Mo steel, so that alloy carbide precipitation occurred at a lower temperature (650°C) in the modifications than in the base steel (800°C).

4444 (CONF-801079—, pp IV.1-IV.7) **Testing and development of materials for catalytic coal gasification process equipment.** Heystek, H.; Raymon, N.S. (Bureau of Mines, University, AL). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

At present, few data are available to aid in selecting metal and refractory materials for reliable, low-cost service under the conditions prevailing in the CCG reactor itself. The combined action of alkali metal hydroxides and hydrogen sulfide in an atmosphere containing high partial pressures of steam, hydrogen, methane and carbon monoxide will make difficult the materials selection for component long-term integrity. The objectives of this research are to: (1) determine the effect of CCG environments on metal and refractory materials of construction by exposure to CCG reactor conditions in a laboratory simulator and (2) identify the attack mechanisms of CCG environments on metals and refractories so that materials offering improved performance at lower cost can be identified. Laboratory exposures of candidate materials to CCG environments have been initiated with 100-hour screening tests of candidate metal and refractory materials. These short-term tests are being followed by a 2,000-hour exposure test of the most promising materials. Another major observation is that aluminized coatings on the alloys are very susceptible to alkali attack, by both vapor phase and char. Several candidate alloys were deleted from long-term exposure following the screening tests because of excessive corrosion.

4445 (CONF-801079—, pp IV.13-IV.17) **Selection of refractories for slagging coal-conversion systems.** Kennedy, C.R. (Argonne National Lab., Argonne, IL). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Refractory bricks supplied by commercial vendors are being evaluated for use under slagging conditions. A variety of refractory compositions are being exposed to both basic and acidic slags in laboratory corrosion tests with and without water cooling. Samples of refractories that have been in service in pilot plants have also been obtained for examination. Attack mechanisms are determined through posttest metallographic and SEM examinations. The most promising refractories will be subjected to longer-duration exposures in a large-scale test facility currently being built at IITRI. Refractory selection and evaluation involve close cooperation with the refractory manufacturers and are based on chemical compatibility, mechanical and thermal properties, ease of fabrication, and cost.

4446 (CONF-801079—, pp IV.25-IV.31) **Improvement of the mechanical reliability of monolithic refractory linings for coal gasification process vessels.** (Babcock & Wilcox Co., Lynchburg, VA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Eighteen heat-up tests were run on nine standard and experimental dual component monolithic refractory concrete linings. The results obtained indicated that the test facility produced lining degradation on the standard type. Lining peformance was improved for Lining # 9 through a systematic study of the cracking that occurred in the previous eight linings, the analysis of the lining strains, shell stresses and acoustic emission results obtained on these linings and the stress analyses performed on the standard and experimental lining designs with the 1 and 2D finite element analysis models developed on this contract. The material, design and operating procedure guidelines which led to this improved performance are described.

4447 (CONF-801079—, pp IV.32-IV.33) **Model for heat flow through refractory linings.** Schorr, J.R. (Battelle Columbus Labs., Columbus). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

A steady-state heat flow model, which appears to have general applicability was developed and experimentally verified for multicomponent refractory walls likely to be used in coal gasification and other types of process vessels. Gas-filled pores, multiple solid phases, cracks, voids, and anchors are specified on a statistical basis as input for the generalized effective conductivity model, which was named CONBEC (Connected Block Conductivity). In order to allow for nonlinear temperature effects, material differences, and approximate location effects, a series of connected effective-conductivity blocks are provided and these are cross linked with adjacent points to account for lateral heat flow. Shape and orientation effects are determined by a shape factor which can be varied between the limiting cases of series and parallel heat flow.

4448 (CONF-801079—, pp IV.34-IV.37) **Fracture of refractory concretes.** Bradt, R.C. (Pensylvania State Univ., University Park). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The properties of refractory concretes have been measured from room temperature through 1200°C. They include the elastic moduli (E, G, and ν), the 3-point flexural strength (MOR), the fracture toughness (K/sub Ic/), the work-of-fracture (γ/sub wof/), and the slow crack growth characteristics (K/sub I/-V) diagram determined by the double torsion method. The trends in these properties have been correlated with physical changes as monitored by thermal gravimetric analysis, differential thermal analysis, density measurements, and x-ray diffraction analysis of the phases present. In general, three temperature ranges were identified to correlate with the property trends: (i) a low temperature region, from room temperature to about 400°C, where the bonds are hydraulic in nature; (ii) an intemediate temperature range from about 400°C to about 900°C; and (iii) a high temperature region above 900°C where ceramic bonds begin to form by sintering processes. The magnitudes of the properties of these concretes can be ascribed to specific characteristics of the aggregate and cement constituents. The study of the aggregate distributions in the high purity cements revealed that subtantial density increases could be achieved using the gap sizing approach to aggregate grading. In particular, it was observed that the use of a gap sized aggregate grading could result in substantial increases of the work-of-fracture. The increases in the work-of-fracture for the gap sized concretes were reflected in their improved thermal shock damage resistance.

4449 (CONF-801079—, pp IV.38-IV.41) **Stability of SiC, Si_3N_4, Si_2N_2O, sialon and chromium oxide-containing refractories in coal gasification environments.** Muan, A. (Pennsylvania State Univ., University Park). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Coal gasifiers operated at sufficiently high temperatures (~ 1400°C) to reject the coal ash in the form of a liquid phase (slag) have potential operating advantages as well as higher efficiencies than gasifiers operated at lower temperatures (~ 1000°C). However, increasing the temperature of a process places heavier demands on the refractory materials used for lining the reaction vessels. The objectives of the present research are to determine the chemical constraints affecting the performance of refractory materials under experimental conditions corresponding to those prevailing in slagging gasifiers, and to provide guidelines for selecting optimum compositions of such refractories. Testing of refractories under atmospheric conditions closely resembling those of slagging coal gasifiers has established that chromium oxide-containing refractories show particular promise in high-temperature gasifiers because of their high resistance to slagging attack. The present research is concerned with stability relations among various refractory components and their reaction products with slags, under temperature-atmosphere conditions approximating those encountered in coal gasification processes. Specifically, the investigation at the present time is concerned with stability relations among phases in the system CaO-MgO-"FeO"-Al_2O_3-Cr_2O_3-SiO_2 at high temperatures and under atmospheric conditions approximating those encountered in coal gasification processes. During the past year, work has been concentrated in two main areas, viz. (1) Phase relations in the system CaO-Al_2O_3-Cr_2O_3 in CO_2-H_2 atmospheres of ratios 10:1; and (2) Phase relations within selected volumes of the four-component system CaO-Al_2O_3-Cr_2O_3-SiO_2 in CO_2-H_2 atmospheres of ratio 10:1.

4450 (CONF-801079—, pp IV.42-IV.53) **Creep behavior of monolithic refractory materials.** McGee, T.D.; Smyth, J.R. (Iowa State Univ., Ames). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Refractory concretes appear to be prime candidate materials for the linings of dry ash coal gasification pressure vessels. Due to the extreme conditions in the gasification process (temperatures to 1200°C, stresses to 2000 psi, corrosive atmsophere) it is important to have available high-temperature high stress creep data for these materials. Not only is data important but also information on the mechanisms of creep is desirable. This information is needed for on-

going research at other institutions into elimination of cracking in the refractory linings which causes failure. The three main objectives of this research are: 1) to evaluate the short- and long-term creep behavior of refractory concretes utilized in the linings of coal gasification process vessels as related to starting composition, microstructure, and microstructural changes; 2) to determine the creep mechanisms in these materials as a function of composition and stress-strain/temperature history; and 3) to obtain data that can be used in mathematical models developed in DOE's Materials for Coal Conversion and Utilization programs.

4451 (CONF-801079—, pp IV.54-IV.55) **Design, engineering and evaluation of refractory liners for slagging gasifiers.** Firestone, R.F. (IIT Research Inst., Chicago, IL). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objectives of this program are: a. to develop refractory liner systems which will provide maximum refractory life with minimum heat losses; b. to determine the rate of wear of refractory liner systems under conditions simulating actual conditions in low- and high-Btu slagging gasifiers and to develop mathematical models for life prediction; c. to develop design practices and specifications for refractory liners for large slagging gasifiers which can perform for at least two years with only routine annual maintenance; and d. to prepare a liner design handbook which will communicate the results of this program to gasifier designers, builders and users.

4452 (CONF-801079—, pp V.22-V.26) **Hot corrosivity of coal gasification products on gas turbine alloys.** Meier, G.H.; Stoehr, R.A.; Gulbransen, E.A. (Univ. of Pittsburgh, PA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The present investigation has resulted in extensive data evaluation and the construction of condensed phase stability diagrams for most of the metal-sulfur-oxygen systems of interest in high temperature corrosion. Furthermore, the more extensive set of vapor species diagrams in existence has been constructed for the metal-oxygen systems and metal-sulfur systems of interest. Condensed phase stability diagrams have also been compiled for a large number of metal-carbon-oxygen systems and work has started on diagrams for metal-nitrogen-oxygen systems and metal-chlorine-oxygen systems. Vapor species diagrams for selected metal-chlorine systems have also been constructed. The high temperature corrosion of turbine alloys associated with deposits likely to condense on components when fuels derived from coal are used has been studied for a wide range of alloy and deposit compositions. The results of this investigation have produced mechanisms for the hot corrosion of a number of pure metals and alloys in atmospheres relevant to turbines using coal conversion products as fuel. The results of these mechanistic studies suggest several conclusions regarding applications of alloys which are discussed.

4453 **(DOE/ET/03297—1) Development of unique catalysts for hydrodenitrogenation of coal-derived liquids. Annual report, September 15, 1978-September 14, 1979.** Katzer, J.R.; Stiles, A.B.; Kwart, H. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1 Oct 1980. Contract AS22-78ET03297. 192p. NTIS, PC A09/MF A01.

Preliminary results from decahydroquinoline hydrodenitrogenation runs show that Bronsted acidity by itself will not catalyze carbon-nitrogen bond scission. The C-N bond cleavage must therefore be catalyzed by an active site, which consists of a transition metal ion in close proximity to an acid site. It appears that hydrodenitrogenation requires both an acidic and a basic site for the Hoffman E_2 elimination reaction to occur. Several catalysts have been prepared and tested, including Bronsted and Lewis acid catalysts without metal, and silica-alumina and γ-alumina impregnated with molybdenum, vanadium, nickel or iron. Our results show that the nitrogen removal rate was highest for molybdenum on γ-alumina catalyst and the rate decreased with lower Mo concentrations. Aluminum borate and aluminum borate phosphate catalysts (with or without nickel) were prepared to develop novel catalysts that would selectively coordinate the nitrogen atom and remove it without excessive hydrogenation. Results show that the support plays an important role in the nitrogen-removal process. Hydrodenitrogenation of aniline has been studied over a presulfided Ni-Mo/γ-Al_2O_3 catalyst, and a reaction network has been proposed. Aniline hydrodenitrogenation appears to involve partial hydrogenation of the benzene ring to reduce aromatic resonance with the nitrogen atom, thus reducing the C-N bond strength and facilitating NH_3 elimination.

4454 **(DOE/ET/10296—66(Vol.1)) Molten salt coal gasification process development unit. Phase 1. Volume 1. PDU operations. Final report.** Kohl, A.L. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). May 1980. Contract AC03-77ET10296. 196p. NTIS, PC A09/MF A01.

This report summarizes the results of a test program conducted on the Molten Salt Coal Gasification Process, which included the design, construction, and operation of a Process Development Unit. In this process, coal is gasified by contacting it with air in a turbulent pool of molten sodium carbonate. Sulfur and ash are retained in the melt, and a small stream is continuously removed from the gasifier for regeneration of sodium carbonate, removal of sulfur, and disposal of the ash. The process can handle a wide variety of feed materials, including highly caking coals, and produces a gas relatively free from tars and other impurities. The gasification step is carried out at approximately 1800°F. The PDU was designed to process 1 ton per hour of coal at pressures up to 20 atm. It is a completely integrated facility including systems for feeding solids to the gasifier, regenerating sodium carbonate for reuse, and removing sulfur and ash in forms suitable for disposal. Five extended test runs were made. The observed product gas composition was quite close to that predicted on the basis of earlier small-scale tests and thermodynamic considerations. All plant systems were operated in an integrated manner during one of the runs. The principal problem encountered during the five test runs was maintaining a continuous flow of melt from the gasifier to the quench tank. Test data and discussions regarding plant equipment and process performance are presented. The program also included a commercial plant study which showed the process to be attractive for use in a combined-cycle, electric power plant. The report is presented in two volumes, Volume 1, PDU Operations, and Volume 2, Commercial Plant Study.

4455 **(DOE/ET/10296—66(Vol.2)) Molten salt coal gasification process development unit. Phase 1. Volume 2. Commercial plant study. Final report.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). May 1980. Contract AC03-77ET10296. 106p. NTIS, PC A06/MF A01.

This report summarizes the results of a test program conducted on the Molten Salt Coal Gasification Process, which included the design, construction, and operation of a Process Development Unit (PDU). This process, coal is gasified by contacting it with air in a turbulent pool of molten sodium carbonate. Sulfur and ash are retained in the melt, and a small stream is continuously removed from the gasifier for regeneration of the salt. The process can handle a wide variety of feed materials, including highly caking coals, and produces a gas relatively free from tars and other impurities. The gasification step is carried out at approximately 1800°F. The PDU was designed to process 1 ton per hour of coal at pressures up to 20 atm. It is a completely integrated facility including systems for feeding solids to the gasifier, regenerating sodium carbonate for reuse, and removing sulfur and ash in forms suitable for disposal. Five extended test runs were made. The observed product gas composition was quite close to that predicted on the basis of earlier small-scale tests and thermodynamic considerations. All plant systems were operated in an integrated manner. Test data and discussions regarding plant equipment and process performance are presented. The program also included a commercial plant study which showed the process to be attractive for use in a combined cycle, electric power plant. The report is presented in two volumes, Volume 1, PDU Operations, and Volume 2, Commercial Plant Study.

4456 **(DOE/FE—0010) Coal conversion. 1979 technical report.** (Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Processing). Sep 1980. 185p. NTIS, PC A09/MF A01.

Individual reports are made on research programs which are being conducted by various organizations and institutions for the commercial development of processes for converting coal into products that substitute for these derived from oil and natural gas. Gasification, liquefaction, and demonstration processes and plants are covered. (DLC)

4457 **(DOE/PC/30252—T1) Hydrogen bonding in asphaltenes and coal liquids. Quarterly report, August 1, 1980-October 31, 1980.** Li, N.C.; Jones, L.; Yaggi, N.F. (Duquesne Univ., Pittsburgh, PA (USA). Dept. of Chemistry). 1980. Contract AC22-80PC30252. 37p. NTIS, PC A03/MF A01.

A coal-derived liquid (SRC-II) and its fractions have been characterized by 600 MHz ^1H NMR spectrometer. Saturate fraction, being 8.1% by weight of unfractionated coal-liquid, is mainly composed of n-alkanes of high carbon numbers and the content of cycloalkanes is negligible. Aromatic fraction (49.0%) contains a considerable amount of partially hydrogenated polynuclear compounds. Double resonance techniques have been used for chemical shift identification of β-CH_2 and α-CH_2 protons attached to aromatic ring structures. The decoupled signals may be used for quantitative analysis of donor hydrogens, which are known to be effective in hydrogen-transfer phenomenon in coal-liquefaction processes. The aromatic fraction contains larger amounts of CH_3 group attached to condensed aromatic ring structures, which appear as singlets in the region of 2.4 to 2.7 ppM, whereas in acidic fractions almost all benzylic CH_3 groups are attached to mono-aromatic ring structure (chemical-shift range of 2.2 to 2.3 ppM). The relatively strong acidic fraction, Acid-II (15.0%), can be recovered from anion-exchange resin by the elution with CO_2 saturated methanol after the elution with benzene. Acid-II is substantially composed of alkyl substituted mono-aromatic phenols and 75% of the fraction boil in the narrow boiling-point range of 461 to 516 K (370 to 470 F).

4458 **(FE—0496-176) Solvent refined coal (SRC) process. Quarterly technical progress report, July 1979-September 1979.** (Pittsburg and Midway Coal Mining Co., Denver, CO (USA)). Feb 1980. Contract AC01-76ET10104. 144p. NTIS, PC A07/MF A01.

This report summarizes the progress of the Solvent Refined Coal project by the Pittsburg and Midway Coal Mining Co. for the Department of Energy for the period June 25, 1979 through September 30, 1979. Except for brief periods, the Fort Lewis Pilot Plant continued to operate in the SRC-I mode and to process Kentucky No. 9 and 14 coal from Pittsburg and Midway's Colonial Mine. Testing of the Lummus Antisolvent Deashing Unit resumed July 21 and continued to operate through August 20, but prolonged steady state operation was not achieved. The Pilot Plant was shutdown August 25 to complete the installation of the new preheater in Area 02, for annual inspection, for conversion to SRC-II mode operation, and for extensive modifications to Areas 01 and 04. Operation is scheduled to resume the week of October 12 in the SRC-II mode to test the new Area 02 preheater. Process Development Unit P-99 was down during July for the annual summer trunaround. Returning to lined out conditions on coal after the turnaround was delayed by a series of equipment failures. After these problems were overcome, two runs (Runs 56 and 57) were completed. These runs, made on Powhatan No. 5 Mine coal, showed that C_5-900°F distillate yield increased about 5% as pressure was increased from 2000 to 2500 psig.

4459 (FE—0496-176, pp 89-103) **Chemical analysis and leaching of coal conversion solid wastes. Appendix C.** Griffin, R.A.; Schuller, R.M.; Russell, S.J.; Shimp, N.F. (Univ. of Illinois, Urbana). Feb 1980.

In Solvent refined coal (SRC) process. Quarterly technical progress report, July 1979-September 1979.

Five solid wastes from coal conversion processes were characterized chemically and mineralogically. The wastes included three Lurgi gasification ashes and mineral residues from the SRC-I and H-Coal liquefaction processes. Chemical analyses of the solid wastes were performed for 60 constituents. Mineralogical characterization of the solid wastes was carried out using x-ray diffraction, Moessbauer spectroscopy, scanning electron microscopy, and optical techniques. Leachates generated from the solid wastes at eight pH levels and under two different gas atmospheres were analyzed for over 40 chemical constituents. Thermodynamic speciation of inorganic ions and complexes in solution were modeled. There were 115 aqueous species considered in the model, and saturation data were computed for over 100 minerals. Results of the mineralogical characterization and leachate analyses showed a wide range in constituent concentration and in the minerals present in the solid wastes. However, thermochemical modeling demonstrated that similar mineral phases controlled the aqueous solubility of the major ionic species for all five solid wastes.

4460 (FE—0496-176, pp 130-138) **Identification of potential pollutants from coal conversion wastes. Appendix E.** Schuller, R.M. (Illinois State Geological Survey, Urbana); Suloway, J.J.; Griffin, R.A.; Russell, S.J.; Childers, W.F. Feb 1980.

In Solvent refined coal (SRC) process. Quarterly technical progress report, July 1979-September 1979.

Seven solid wastes from coal conversion processes were characterized chemically and mineralogically. The wastes included three LURGI gasification ashes, two liquefaction residues (SRC and H-coal), a fly ash, and a water-quenched slag. Leachates generated from the solid wastes at various pH levels over the range 2.5 to 11.0 were analyzed for over 40 constituents. Results of the leachate analyses demonstrate the wide variation in constituent solubility for the solid wastes. To help assess the environmental impact of the disposal of these wastes, the leachates were also employed in soil attenuation studies and acute 96-hour static bioassays using young fathead minnows.

4461 **(FE—2340-2A) Improved techniques for gasifying coal. Second annual report, July 1, 1977-June 30, 1978.** Graff, R.; Yerushalmi, J. (City Univ. of New York, NY (USA)). Jul 1978. Contract AS01-76ET10623. 173p. NTIS, PC A08/MF A01.

Work during the second year has focused on the delineation of the various fluidization regimes, and their boundaries. Experiments have been conducted with several solids in both the two-dimensional bed and the 6-inch columns. The results also throw light on the phenomenon of choking. Work has begun on the design of reactors for flash hydrogenation at the commercial scale with the objective of placing alternative systems before the technical community along with our recommendations. It is immediately apparent that dilute phase transport reactors, which are presently being put forward for commercialization, suffer from three disadvantages: (1) they are operable only at high temperatures, beyond the range for optimum production of light liquids; (2) hydrogen for solids transport is about 10 times the stoichiometric requirement. This makes heat management difficult and product separation expensive; (3) excessively high hydrogen feed temperatures are required. These are beyond the capability of indirectly fired heaters and can be met only by direct combustion with oxygen. A consideration of the operating characteristics of high velocity beds suggests that they would obviate these disadvantages. We have, thus far, concentrated on the ability of high velocity beds to reflux the exothermic heat of reaction, thereby reducing the hydrogen preheat requirements. Heat balance calculations show that these requirements are well within the range of indirectly fired heaters.

4462 **(FE—2729-11) Alloy catalysts with monolith supports for methanation of coal-derived gases. Final technical progress report, September 20, 1977-September 20, 1980.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)). 5 Oct 1980. Contract AS01-77ET10505. 127p. NTIS, PC A07/MF A01.

The activity, selectivity and stability of alumina-supported nickel and nickel bimetallics in methanation of CO was investigated. Support geometry, in situ H_2S poisoning tests, and carbon deposition tests initiated during the previous contract were completed. The results show that: (1) at high conversions and high through-put conditions monolithic supported catalysts are more active than pellet supported catalysts; (2) Ni-MoO_3 is more active and sulfur resistant than Ni, and (3) in carbon deposition tests Ni-Pt and Ni-Co maintain catalytic activity longer than Ni. High temperature reactor tests reveal that catalysts prepared in this laboratory are more

active and in some cases more thermally stable than commercial catalysts and that carbon deposition is a major factor but not the only factor causing deactivation at high temperatures. A comprehensive investigation of methanation kinetics over nickel (and to a lesser extent ruthenium) and deactivation by carbon was conducted. The results provide significant insights into the mechanisms of the reaction and the deactivation by carbon. Effects of temperature, H_2S concentration, and other reaction variables on the sulfur poisoning rate of nickel during methanation were also investigated. The results provide a basis for modeling the deactivation process and predicting catalyst life. These and other significant results are presented and discussed.

4463 **(IS—4750) Alloy evaluation for fossil fuel process plants (liquefaction). Quarterly report, 1 April-30 June, 1980.** Woods, C.M.; Scott, T.E. (Ames Lab., IA (USA)). 15 Jul 1980. Contract W-7405-ENG-82. 37p. NTIS, PC A03/MF A01.

The average thermal expansion coefficient for Carpenter 883 (H-13, the bolt material for bolt loaded compact tension specimens) was determined for the temperature range 72°F to 800°F. The thermal stability, as a function of time, was determined at 800°F. The average thermal expansion coefficients for both A387-74A-Gr.22-Cl.2 steel and 316 stainless steel were determined for the 72°F to 1000°F temperature range. Thermal stability of A387 at 1000°F was monitored for a period of 250 hours. Smooth-bar and notched-bar tensile specimens of A387-74A-Gr.22-Cl.2 steel were exposed to 4000 psig H_2 gas at 1000°F for 168, 250 and 500 hours. Samples were exposed in the unstressed, stressed, and prestrained conditions. Tensile tests were made in air at room temperature at the end of each exposure. Metallographic examinations were made of fracture surfaces as well as other exposed specimens not subjected to the tensile testing. The exposed material exhibited a marked reduction in notch ductility as well as a small reduction in notch tensile strength. The smooth-bar samples showed no significant changes in mechanical properties even after 500 hours of exposure. SEM examinations revealed the presence of small bubbles that formed mostly on or near grain boundaries and in the vicinity of second phase particles. Specimens cleaved at liquid nitrogen temperature exhibited bubbles on the fracture surface. Fatigue crack growth rates (da/dN) were determined for a wide variation of stress intensity range values (ΔK). Testing was done in hydrogen gas at ambient temperature and various pressures. Near-threshold to rapid crack growth stages were examined.

4464 **(NYSERDA—80-5) Coal gasifier wall protection system.** (Bell Aerospace Textron, Buffalo, NY (USA)). Apr 1980. 127p. NYSERDA, Rockefeller Plaza, Albany, NY.

Excessive slag accumulation on the walls of small, high mass flux coal gasifiers can seriously reduce their operating efficiency. Thickly deposited layers of slag interfere with proper mixing and reaction, particularly in recirculation regions around injectors. As a consequence, the full potential of these coal conversion systems are only partially realized. One such system, currently under development, is the Bell HMF Gasifier. Part of its overall development deals with liner systems not only from the standpoint of erosion and corrosion, but also with respect to slag accumulation. Current approaches to gasifier inner wall design utilize refractories to which slag readily adheres. An approach to preventing this would be to select materials that are non-wetting to slag. Furthermore, there is evidence that chilled surfaces prevent slag adherence. The approach used in this study was to test wall systems which combined both slag repellant materials and active cooling to determine their effectiveness in reducing slag accumulation. The results of these tests show that the adherence of slag deposits sprayed onto actively cooled materials depends on wetting tendency, surface temperature, and surface roughness. For example, liquid slag accumulates on ceramic oxides partly because they have a strong wetting tendency. Moreover, because of comparatively low thermal conductivity and tensile strength, cooling to sufficiently low temperature to inhibit slag adherence risks thermal shock failure. On the other hand, smooth alloys and carbon/graphites chilled to sufficiently low surface temperatures provide a basis for designing effective slag free wall protection systems for high mass flux slagging gasifiers.

4465 **(ORNL/MIT—316) Characterization of heat transfer in preheaters of bench-scale, solvent-refined coal apparatus.** Trevino-Lozano, R.A.; Baars, D.M.; Keitelman, E.N. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Dec 1980. Contract W-7405-ENG-26. 57p. NTIS, PC A04/MF A01.

The heat-transfer characteristics of the Coal Liquids Flow System preheater at Oak Ridge National Laboratory were examined by calculating the heat of reaction of the slurry at various temperatures, the bulk temperature profile along the preheater, and the local heat-transfer coefficients. The heat of reaction was small relative to the heat input to the preheater. The calculated fluid-temperature profile is within 7 K of two experimentally measured fluid temperatures in the preheater, and the heat-transfer coefficient follows behavior predicted by both the physical properties of the slurry and empirical heat transfer correlations for laminar flow. An empirical correlation was developed which predicts calculated heat-transfer coefficients.

4466 **(PB—80-810039) Underground coal gasification (citations from the NTIS Data Base). Report for 1964-1978.** Cavagnaro, D. (National Technical Information Service, Springfield, VA (USA)). May 1980. 242p. NTIS PC N01/MF N01.

Research reports on in-situ coal gasification are cited. Some of the techniques include rock fracturing, combustion, gas removal, economic, costs, and environmental factors. (This updated bibliography contains 235 abstracts, none of which are new entries to the previous edition.)

4467 **(PB—80-810047) Underground coal gasification (citations from the NTIS Data Base). Report for 1979-Apr 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1980. 100p. NTIS PC N01/MF N01.

The bibliography of Federally-sponsored research cites many aspects of in-situ gasification techniques, including rock fracturing, combustion, gas removal, economics, costs, and environmental factors. (This updated bibliography contains 93 abstracts, 53 of which are new entries to the previous edition.)

4468 **(PB—80-810054) Underground coal gasification (citations from the Engineering Index Data Base). Report for 1970-Apr 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1980. 276p. NTIS PC N01/MF N01.

The bibliography presents worldwide research pertaining to underground (in-situ) coal gasification. It includes environmental effects, the different processes and techniques that are used, gas removal, rock fracturing, costs, and economics. (This updated bibliography contains 269 abstracts, 106 of which are new entries to the previous edition.)

4469 **(UCRL—84610) Solar coal gasification: plant design and economics.** Aiman, W.R.; Thorsness, C.B.; Gregg, D.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 5 Nov 1980. Contract W-7405-ENG-48. 50p. (CONF-801104—6). NTIS, PC A03/MF A01.

From 73. annual meeting of the American Institute of Chemical Engineers; Chicago, IL, USA (12 Nov 1980).

The present paper is one further step in developing the concept of Solar Coal Gasification. A plant was layed out and analyzed with the aid of a code that calculates process flows and plant economics. This plant is the simplest, most straight-forward plant and thus the most appropriate for initial analysis. Solar Energy is focused directly on the reacting coal. The process analysis shows that 40% more product can be produced from a given amount of coal and that the fraction of the solar energy that can be converted into usable energy is greater than that for any other method with the exception of conversion to simple thermal energy. The economic analysis shows that for a gasification plant that produces a given amount of product per year, the capital costs are much higher but the operating costs are much lower. These cost differences reflect the 8 hr per day operation and the lower coal consumption for the SCG plant. Product costs were derived as a function of coal cost.

The Lurgi plant was more economical when coal was less than about $3/gJ. The SCG plant was more economical when coal was more than about $3/gJ. Currently Coal Week shows most coal costs between $1/gJ and $2.gJ. Mine-mouth coal is cheaper than the coal listed in Coal Week. Eventually coal prices may rise to a level (relative to plant costs) where the simple, straightforward SCG plant will be cheaper than a Lurgi plant. In the meantime we should look for better SCG concepts. Alternative concepts being considered for economic and practical reasons include: indirect gasification using a heat transfer fluid, hybrid gasification using solar energy when available and coal combustion energy at other times, syn gas storage so that the downstream processing units can continue through the night, and solar energy storage so that gasification can continue through the night.

4470 **Determination of biological removal of organic constituents in quench waters from high-Btu coal-gasification pilot plants.** Stamoudis, V.C. (Argonne National Lab., IL); Luthy, R.G. *GBWater Research (Supersedes in Part Air and Water Pollution) (England);* **14**: 1143-1156(1980).

Studies were initiated to assess the efficiency of bench scale, activated-sludge treatment for removal of organic constituents from coal-gasification process effluents. Samples of pilot plant, raw-gas quench waters were obtained from the HYGAS process of the Institute of Gas Technology and from the slagging, fixed-bed (SFB) process of the Grand Forks Energy Technology Center. The types of coal employed were Bituminous Illinois No. 6 for HYGAS and Indian Head lignite for SFB process. These pilot plant quench waters, while not strictly representative of commercial condensates, were considered useful to evaluate the efficiency of biological oxidation for the removal of organics. Removal efficiency of base-reaction organics was generally good, except for certain alkylated pyridines. Removal of neutral-fraction organics was also good, except for certain alkylated benezenes, certain polycyclic aromatic hydrocarbons, and certain cycloalkanes and cycloalkenes, especially, at low influent concentrations.

4471 **Char reactivities and their relationship to pore characteristics.** Kata, S.; Keairns, D.L. (Westinghouse R & D Center, Pittsburgh, PA). Contract EF-77-C-01-1514. *USAmerican Chemical Society, Division of Fuel Chemistry, Preprints (U.S.);* **25**: No. 4, 19-28(1980). (CONF-800814—P3).

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

Relative reactivities of chars in a H_2O-N_2-H_2 atmosphere were measured in a laboratory fluidized bed. Results were analyzed on the basis of Ergun's rate equation, and the relative reactivities were calculated with reference to coke breeze. Surface areas of chars were obtained by means of CO_2 adsorption, and pore volumes were measured by means of mercury penetration porosimetry. A correlation can be identified between the relative reactivity versus the surface areas and the mean pore diameter for the limited number of chars investigated in the present study. Additional studies should be conducted to establish the range of validity with additional chars and drawbacks of this approach.

4472 **Kinetics and mechanisms of the hydroliquefaction of coal: Illinois No. 6, Burning Star coal in SRC-II heavy distillate.** Thomas, M.G.; Bickel, T.C. (Sandia National Labs., Albuquerque, NM). *USAmerican Chemical Society, Division of Fuel Chemistry, Preprints (U.S.);* **25**: No. 4, 95-102(1980). (CONF-800814—P3).

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

The study was conducted to obtain rates of reaction and activation energies for one coal (Illinois No. 6, Burning Star high volatile bituminous coal) and one solvent (coal-process derived SRC-II Heavy Distillate). Coal-to-solvent ratio, reaction time, temperature, and pressure are variables in a parametric study between 275°C and 475°C. Two different types of reactors were used - a microreactor system for screening and a continuous flow reactor for the derivation of kinetic data. No attempt to generalize the results is made.

4473 **in situ study of rapid coal pyrolysis using FTIR.** Freihaut, J.D.; Solomon, P.R.; Seery, D.J. (United Technologies Research Center, East Hartford, CT). Contract ET-78-C-01-3167. *USAmerican Chemical Society, Division of Fuel Chemistry, Preprints (U.S.);* **25**: No. 4, 161-170(1980). (CONF-800814—P3).

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

A reactor has been constructed in which small samples of coal (20 to 60 mg) are rapidly injected (25 msec) into a preheated environment. The injection device allows one to deliver particles as small as 100 μm or as large as several millimeters in diameter. Injection of the small samples into a preheated zone insures that the particles experience initial heating rates comparable to those expected in coal combustors. The gases produced by the thermal decomposition process are monitored in situ by use of a Nicolet FTIR spectrometer operated in the rapid scan mode. This pyrolysis configuration has been useful in determining the validity of hypotheses formulated by studies performed with the heated grid apparatus. However, in its current configuration it is not without its disadvantages: calibration of the reactor is extremely difficult; the alumina walls tend to provide active sites for the transformation of sulfur-containing gases; the tar soot mist formed at higher operating temperatures and by use of smaller particle sizes tends to interfere with the IR signal.

4474 **Thermochemical effects of gas-coals in pyrolysis process.** Wang, Z.; Shou, J.K. (Univ. of Kentucky, Lexington). *USAmerican Chemical Society, Division of Fuel Chemistry, Preprints (U.S.);* **25**: No. 4, 171-179(1980). (CONF-800814—P3).

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

This study of thermographical curves and corresponding assay data of gas-coals at peak temperatures has shown that thermal effects were closely connected with the decomposition of coal organic matter and its changes in chemical composition. After the second peak (exothermic) temperature, gas-coals started to decompose intensely. Thermal decomposition was initiated from hydrogen- and oxygen-rich thermally unstable constituents. The evolution of volatile carbon from solid substances was concentrated in the temperature range between the second and third peaks. The control of thermal decomposition before reaching the exothermic peak within the W-shape is of great importance. Improving interreaction between volatile carbon and free hydrogen, coal pyrolysis and other coal conversion processes could be improved to yield a greater amount of hydrocarbon products. Beyond the second endothermic peak within the W-shape, the atomic ratio of carbon to the sum of other elements in nonvolatilized material increased markedly. The aromaticity of nonvolatilized material tends to increase with the rise of the carbonization degree.

0106 Properties

4475 **(DOE/BETC/4162—10) Stability characteristics of some shale and coal liquids. Final report.** Bowden, J.N. (Southwest Research Inst., San Antonio, TX (USA)). Nov 1980. Contract AB03-77ET11450. 56p. NTIS, PC A04/MF A01.

Liquid hydrocarbon fuels derived from coal and from oil shale were made available for characterization and thermal and storage stability investigations. The coal-derived liquids identified as naphthas from No. 6 Illinois and Wyodak coals produced by the Exxon Donor Solvent process contained high concentrations of oxygen, nitrogen, and sulfur compounds and were considered to be unrefined synthetic crudes. These materials were found to be relatively unstable in storage. The shale-derived fuels were refined to meet the requirements of military specification jet fuels JP-8 and JP-5 and marine diesel fuel (DFM). Virtually all the specification requirements were met and the fuels were found to be thermally and storage stable. During 32-week, 43°C storage tests conducted on these liquids, periodic measurements were made of precipitate fuel-insolubles, fuel-soluble gum, dissolved oxygen content and peroxide number. The liquids were analyzed, in some instances, by in-

frared, NMR, and uv spectroscopy, before and after the 32-week storage test with little or no change being observed in the bulk liquid samples. Shale-derived liquid hydrocarbons have been refined to meet current specification requirements for hydrocarbon fuels, and it appears that coal-derived liquids can also be refined to meet requirements for performance and storage stability.

4476 **(DOE/ET/13350—T2) Characterization and evaluation of washability of Alaskan coals. Final technical report for Phase II, July 1, 1977-February 29, 1979.** Rao, P.D.; Wolff, E.N. (Alaska Univ., Fairbanks (USA). Mineral Industry Research Lab.). Oct 1980. Contract FG22-78ET13350. 53p. NTIS, PC A04/MF A01.

This report is a result of the second part of a continuing study to obtain washability data for Alaskan coals to supplement the efforts of the US Department of Energy in their ongoing studies on washability of US coals. Alaska, with its large coal resources, could supply the nation with environmentally acceptable low-ash, low-sulfur coals. Washability characteristics were determined for eleven coal samples, from the Northern Alaska, Broad Pass, Little Tonzona, Tramway Bar, Beluga, Yentna, Kenai and Nenana coal fields. The raw coals were crushed to 1-1/2 inches, 3/8 inch and 14 mesh top sizes and float-sink separations were made at 1.30, 1.40, and 1.60 specific gravities. Detailed results of the testing are given.

4477 **(EGN—88) Abundance of trace and minor elements in organic and mineral fractions of coal.** Kuhn, J.K.; Fiene, F.L.; Cahill, R.A.; Gluskoter, H.J.; Shimp, N.F. (Illinois State Geological Survey, Urbana (USA)). Aug 1980. 73p. Illinois Institute of Natural Resources, Urbana, IL.

New data on the abundance and mode of occurrence of trace and minor elements in coal are presented in this report. A summary of related studies previously conducted at the Illinois State Geological Survey is also included. Twenty-seven coals from the eastern, central and western portions of the United States were selected for study in the new phases of this work. Each coal sample underwent acid treatment, and selected coals underwent float/sink and ion exchange treatments. From these treated samples, coal fractions were obtained and analyzed by various methods. An enriched organic-matter fraction virtually free of mineral matter, was prepared by extracting coal under prescribed conditions with dilute nitric, hydrofluoric, and hydrochloric acids. Excluding organic sulfur, the resulting demineralized product contained no detectable coal minerals and only 250 to 600 ppM of ash-forming elements. These elements, and certain of the more volatile ones, are securely bound within the organic coal matrix; consequently, they were termed organically associated. The concept of an organic affinity index was used to measure the tendency of an element to associate with the organic matter in coal. Detailed mineralogic and microscopic analyses of low temperature ash residues were made of gravity separations from nine of the coals. The same mineral data were obtained for 26 of the 28 whole coals studies.

4478 (FE—0496-176, pp 104-129) **Moessbauer spectroscopic studies of the mineralogical changes in coal as a function of cleaning, pyrolysis, combustion and coal conversion processes. Appendix D.** Saporoschenko, M. (Southern Illinois Univ., Carbondale); Hinckley, C.C.; Smith, G.V.; Twardowska, H.; Shiley, R.H.; Griffin, R.A.; Russell, S.J. Feb 1980.

In Solvent refined coal (SRC) process. Quarterly technical progress report, July 1979-September 1979.

The mineralogical changes in a Perry County, Illinois coal from the Herrin (No. 6) Member as a function of cleaning, pyrolysis, combustion, and coal conversion processes have been studied. This study employed Moessbauer spectroscopy in tandem with x-ray diffraction to follow the fate of the iron present in the coal during processing. The chemistry of the pyrite conversion as revealed by this study is less complex than was expected. Iron does not become uniformly distributed among all possible sites, but exhibits preferences which are in effect simplifying. The detailed distribution of iron is dependent upon the particular process equipment in which the coal is used or on the conversion process in which it is being used.

4479 **Structure and reactivity of coal. Char fuels from biomass.** Washington, DC; American Chemical Society (1980). 360p. (CONF-800814—P3). Academic Press Inc., New York, NY 10003 $8.00.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

The 38 papers presented at sessions on fuels from biomass and on structure and reactivity of coal and char are indexed separately.

4480 **Model structure for a bituminous coal.** Heredy, L.A. (Rockwell International Corp., Canoga Park, CA); Wender, I. *USAmerican Chemical Society, Division of Fuel Chemistry, Preprints (U.S.);* **25**: No. 4, 38-45(1980). (CONF-800814—P3).

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

The model coal molecule described in this paper is presented with the following objectives: (1) to incorporate into the model new structural information that has become available in recent years; (2) to derive additional input data for the model molecule by means of a mathematical analysis; and (3) to test the model by comparing the experimentally observed behavior of a high-volatile bituminous coal in a number of chemical reactions with the expected behavior of the model molecule in the same reactions.

0108 Waste Management

REFER ALSO TO CITATION(S) 4509, 4766

4481 **(ARI-RP—60) Homogeneous production and removal of NO/sub x/ from combustion exhaust flows. First quarterly technical summary report.** Silver, J.A. (Aerodyne Research, Inc., Bedford, MA (USA). Center for Chemical and Environmental Physics). Nov 1980. Contract AC21-80MC14737. 19p. NTIS, PC A02/MF A01.

The production and removal of No/sub x/ and other combustion products during fossil fuel combustion is a serious environmental problem for both stationary and mobile energy systems. Since stationary systems are faced with increased utilization of coal, oil shale, or synthetic fuel oils, all of which have significant levels of fuel-bound nitrogen, NO/sub x/ formation may become acute. Recent studies of the production of NO/sub x/ due to oxidation of fuel nitrogen indicate that a critical role is played by the interaction of NH/sub i/ (i = 1,2,3) species with NO, O_2, OH, and H. In fact, these reactions play a vital role in the homogeneous removal of NO/sub x/ from combustion exhaust streams upon addition of NH_3 or NH_3-like compounds. Over the past two years, there has been an increased understanding of the chemistry of the NH/sub i//NO/sub x/ system at combustor exhaust temperatures. For an ammonia addition system to be effective in reducing NO/sub x/ emissions, it must work successfully in the presence of a variety of sulfur-bearing compounds present in the products of combusted coal and oil shale. The work in progress has three major objectives. The first objective is to determine whether the reactions of SO_2 (the predominant sulfur-bearing compound present) + NH/sub i/ (i = 1,2,3) directly produce NO/sub x/ in the temperature range of 300 to 1500 K. Depending on the products and value of these rate constants, the effectiveness of NO removal by NH_3 could be dramatically affected. The second objective is to screen and evaluate various sulfur-containing scavenger precursors such as SO, SO_2, HS, and H_2S to assess their impact on the NH/sub i//NO/sub x/ chemical system.

4482 **(DOE/ET/10533—11) Utilization of coal associated minerals. Quarterly report No. 11, April 1-June 30, 1980.** Slonaker, J.F.; Akers, D.J.; Alderman, J.K. (West Virginia Univ., Morgantown (USA). Coal Research Bureau; West Virginia Univ., Morgantown (USA). Coll. of Mineral and Energy Resources). 29 Aug 1980. Contract AS21-77ET10533. 30p. NTIS, PC A03/MF A01.

The purpose of this research program is to examine the effects of coal mineral materials on coal waste by-product utilization

and to investigate new and improved methods for the utilization of waste by-products from cleaning, combustion and conversion processing of coal. The intermediate objectives include: (1) the examination of the effects of cleaning, gasification and combustion on coal mineral materials; and (2) the changes which occur in the coal wastes as a result of both form and distribution of mineral materials in feed coals in conjunction with the coal treatment effects resulting from coal cleaning or either gasification or combustion.

4483 **(EPRI-CS—1574) Aqueous carbonate process design study. Final report.** McKisson, R.L.; Bauerle, G.L.; Bodine, J.E.; Rennick, R.D.; Stewart, A.E.; Tsang, S. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Oct 1980. 466p. NTIS, PC A20/MF A01.

The Aqueous Carbonate Process (ACP) Design Study involved an experimental investigation of the regeneration subsystem of the Rockwell International Corporation Energy Systems Group closed cycle flue gas desulfurization process. The process involves a spray dryer in which the flue gas is scrubbed and its sulfur removed as a dry sodium sulfite/sulfate plus sodium carbonate mixture. This is followed by a regeneration process which involves the reduction of the sulfite/sulfate to sulfide in a molten salt bed. Then, using the CO_2 produced in the molten salt bed, the sulfide is stripped from an aqueous solution of the melt as H_2S which is oxidized to elemental sulfur in a Claus plant. The sodium salts are concurrently converted to a sodium carbonate solution which is recycled to the spray dryer as the absorbent solution. This program involved studies of the molten salt reduction step and the aqueous regeneration steps plus a corrosion study of the aqueous process liquors. A process flow diagram and a material balance were developed based on coal-reduction process data developed in the study. It was observed that the reduction process was more difficult to operate with coal than with coke. The greater ash content of the coal and thus of the reducer melt, is a major factor in determining the operating temperature of the reducer, with the result that the coal-reduction required a bed temperature about 55°C (100°F) higher than that for coke-reduction. It is concluded that the ACP closed cycle process can operate effectively using coal as the reductant, although the use of coke offers more operational flexibility.

4484 **(FE—2295-32-10) Medium and high temperature gas clean-up of particulates. Quarterly progress report, January 1-April 1, 1980.** (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1980. Contract AT01-76ET10691. 12p. NTIS, PC A02/MF A01.

The EFB exploits the electrical force exerted on charged particles as used in a conventional electrostatic precipitator in combination with the large specific surface area typical of fluidized beds and packed beds. The combination of electric fields and beds has been shown to be especially attractive for the collection of fine particles in a short residence time. This second phase of a program for investigating the applicability of this approach to medium and high-temperature gas clean-up of particles has dual objectives. On the one hand, we are exploring the feasibility of using a highly fluidized state as a method of obviating the increased electrical losses associated with increasing the temperature. On the other hand, there is the broad basic objective of providing a macroscopic model useful for not only the applications envisioned here, but others as well. Such a model requires certain inputs that are best determined by experiment. What is being developed on the basic side in this work is a framework for providing a self-consistent definition of parameters determined experimentally and a method for predicting the performance of systems in which the fields and flows are not uniform, either in orientation or magnitude. Section 2 describes theoretical models and associated room temperature experiments that are being developed. Section 3 covers progress on the design of modifications to the high temperature facilities making possible experiments with highly fluidized beds.

4485 **(FE—2295-32-11) Medium and high temperature gas clean-up of particulates. Quarterly progress report, April 1-July 1, 1980.** (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1980. Contract AT01-76ET10691. 6p. NTIS, PC A02/MF A01.

The new charger is shown. Its advantages derive from charging the diluted aerosol rather than the concentrated output from the particle generator. Charging is now over the complete cross-section of the test column. Tests carried out in conjunction with the analyzer have shown charging with good uniformity for about 90% of the particles. For reasons that are not entirely understood, about 10% of the particles appear to be uncharged. Our approach at this time is to take this as a given property of the charger and to correct efficiency measurements accordingly. Measurements have been made and are being repeated to determine the dependence of S on field magnitude and relative angle between field and flow. Indications are of a stronger dependence of S on this angle than expected and of an optimum angle which is more nearly cross-flow than counter-flow. Considerable time is being spent in obtaining the best possible repeatability of measurements, but it seems clear that the apparatus is capable of giving sufficiently refined data to justify a next step in which the macroscopic measurements are incorporated into a detailed description of a system that is non-uniform on the macroscale. Several different configurations for testing the macroscopic model are being considered.

4486 **(FE—3269-24A) Design, construction, operation and evaluation of a prototype culm combustion boiler/heater unit. Technical progress report, October 1-December 31, 1979.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Feb 1980. Contract AC01-78ET12307. 22p. (CW-WR—78-036.24A). NTIS, PC A02/MF A01.

This report provides a summary of the work performed on the Prototype Culm Combustion Boiler/Heater Unit, Phase I - Engineering Design and Analysis and Limited Phase II - Prototype Plant Construction during the period October 1, 1979 through December 31, 1979. The objectives of the program as well as the technical progress and problem areas encountered are presented. Progress on the components and system engineering studies is described. The Preliminary Design of Prototype Unit Topical Report was submitted. Final design activity is continuing and the progress on drawing preparation and advanced procurement activity is discussed. Based on authorization for a limited amount of Phase II activity, initial Purchase Orders were released authorizing preparation of certified drawings for fabricated equipment required to support the Phase I final design activity. The Purchase Order for site clearance and installation of boiler foundations was awarded and ground breaking ceremonies were held at the Prototype Culm Combustion Boiler site in Paxinos, Pennsylvania, on December 7, 1979.

4487 **(IR—1109) Design guidelines for coal refuse piles and water, sediment, or slurry impoundments and impounding structures.** (Department of Labor, Washington, DC (USA)). 1979. 29p. Mine Safety and NTIS, PC A03/MF A01.

This publication presents the guidelines used by the Mine Waste Branches of the Mine Safety and Health Administration's Denver Technical Support and Pittsburgh Technical Support Centers and by MSHA district managers in their review of engineering plans for coal refuse impoundments. These guidelines give detailed information on the hydrologic, hydraulic, and geotechnical factors that should be considered in planning such structures. A plan review checklist is included.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 4477

0120 Mining

REFER ALSO TO CITATION(S) 4529, 5053

4488 **(BM-RI—8485) Structure response and damage produced by airblast from surface mining.** Siskind, D.E.; Stachura, V.J.; Stagg, M.S.; Kopp, J.W. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center). 1980. 111p. Bureau of Mines, Washington, DC.

The Bureau of Mines studied airblast from surface mining to assess its damage and annoyance potential, and to determine safe levels and appropriate measurement techniques. Research results obtained from direct measurements of airblast-produced structure responses, damage, and analysis of instrument characteristics were

combined with studies of sonic booms and human response to transient overpressures. Safe levels of airblast were found to be 134 db (0.1 Hz), 133 db (2 Hz), 129 db (6 Hz), and 105 db C-slow. These four airblast levels and measurement methods are equivalent in terms of structure response, and any one could be used as a safe-level criterion. Of the four methods, only the 0.1-Hz high-pass linear method accurately measures the total airblast energy present; however, the other three were found to adequately quantify the structure response and also represent techniques that are readily available to industry. Where a single airblast measuring system must be used, the 2-Hz linear peak response is the best overall compromise. The human response and annoyance problem from airblast is probably caused primarily by wall rattling and the resulting secondary noises. Although these will not entirely be precluded by the recommended levels, they are low enough to preclude damage to residential structures and any possible human injury over the long term.

4489 **(DOE/BC/00035—T3) Investigation of water jet drilling for methane drainage. Technical progress report, October-November 1980.** (Sandia Labs., Albuquerque, NM (USA)). 4 Dec 1980. Contract AT19-78BC00035. 5p. NTIS, PC A02/MF A01.

The field tests of the Drilling Head, Drill String and instrumentation system were conducted in the Peabody mine near New Athens, Illinois. The objective of the tests was to evaluate these components of the Water Jet Drilling System by drilling a 200 ft horizontal hole in the coal seam.

4490 **(DOE/ET/12548—1) Overall requirements for an advanced underground coal extraction system.** Goldsmith, M.; Lavin, M.L. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Oct 1980. Contract AI01-76ET12548. 100p. (JPL-PUBL—80-39). NTIS, PC A05/MF A01.

This report presents overall requirements on underground mining systems suitable for coal seams exploitable in the year 2000, with particular relevance to the resources of Central Appalachia. These requirements may be summarized as follows: (1) Production Cost: demonstrate a return on incremental investment of 1.5 to 2.5 times the value required by a low-risk capital project. (2) Miner Safety: achieve at least a 50% reduction in deaths and disabling injuries per million man-hours. (3) Miner Health: meet the intent of all applicable regulations, with particular attention to coal dust, carcinogens, and mutagens; and with continued emphasis on acceptable levels of noise and vibration, lighting, humidity and temperature, and adequate work space. (4) Environmental Impact: maintain the value of mined and adjacent lands at the pre-mining value following reclamation; mitigation of off-site impacts should not cost more than the procedures used in contemporary mining. (5) Coal Conservation: the recovery of coal from the seam being mined should be at least as good as the best available contemporary technology operating in comparable conditions. No significant tradeoffs between production cost and other performance indices were found.

4491 **(DOE/FE/9111—1) Evaluation of CAVIJET cavitating jets for cutting coal-associated rocks. Final technical report.** Conn, A.F.; Cohen, S.H.; Frederick, G.S. (Hydronautics, Inc., Laurel, MD (USA)). Apr 1980. Contract AC01-77ET12514. 151p. NTIS, PC A08/MF A01.

Laboratory specimens of seven rock types, and Illinois No. 6 coal, were cut with CAVIJET cavitating fluid jets. The possibility of using such jets to augment the action of mechanical rock-removal equipment in coal mines was the motivation for this study. The comparative erodibility of the rocks was established, demonstrating that coal-associated types (shales, limestones, sandstones) can be cut by cavitating jets using pressures within the capability of conventional, medium pressure pump systems suitable for coal mine operation.

4492 **(FE—8915(10,12)) Single and dual-pass miner/bolter systems assessment by computer simulation. Final technical report.** Brown, G.R.; Kissel, W.H. (Ketron, Inc., Wayne, PA (USA)). May 1980. Contract AM01-77ET12532. 248p. NTIS, PC A11/MF A01.

The objective of this project was to determine which of five miner/boiler systems hold the most promise regarding productivity and costs. This determination will aid in making decisions of what, if any, further development is needed for improving any of these systems. Two computer models were used to simulate each system. The simulation results indicate that the miner/bolter systems were shown not to be cost-effective in comparison to the standard continuous mining systems. Dual pass mining systems were more cost-effective than the single pass systems. Continuous haulage, for the miner/boiler systems, was another factor which increased production but was not always cost-effective.

4493 **(FE—11268-1) Built-in test equipment for front-end loaders. Final technical report.** Wise, J.; Durborow, S. (Skelly and Loy, Harrisburg, PA (USA)). Jan 1980. Contract AC01-79ET11268. 268p. NTIS, PC A12/MF A01.

The objective of this study was to evaluate the feasibility of using Built-in Test Equipment (BITE) on front-end loaders (FEL) to increase their availability and productivity. Coal mining productivity is constrained in many operations due to the low availability of FEL. BITE systems allow for reductions in unscheduled maintenance downtimes and implementation of efficient preventative maintenance practices. This report illustrates the feasibility of the concept from a technical and economic viewpoint. It provides a representative system hardware description and a preliminary system specification.

4494 **(MTCH-PR—8-79) Communication, monitoring and control.** (Mining Technology Clearing House, Tamworth, Staffordshire (UK)). 1979. 51p. NTIS, PC A04/MF A01.

Research programs of cooperating countries in the International Energy Agency are listed in the areas of communications, monitoring and control of coal mining. The information involves identifying numbers, agency name, project title, synopsis of project giving objectives, description and progress, project leader, associated organizations, starting and expected finish date. (LTN)

4495 **(PB—80-167430) Effectiveness of inclined roof bolts in coal mines. Final report, 28 Jun 77-27 Jun 78.** Singh, M.M. (Engineers International, Inc., Downers Grove, IL (USA)). Jul 1978. Contract J0275031. 115p. NTIS, PC A06/MF A01.

This report presents the results of an investigation of inclined roof bolts, anchored over pillars, in room-and-pillar coal mines susceptible to shear failures of the roof. Although the field data do not support this contention, it is believed on the basis of analyses and other work that inclined roof bolts do offer potential under some circumstances.

4496 **(PB—80-167455) Remote operator coal mine roof bolter concepts utilizing existing techniques and components. Open file report (final), Oct 77-Sep 78.** Hakes, G.; Haviland, T. (Ingersoll-Rand Research, Inc., Princeton, NJ (USA)). Sep 1978. Contract H0272028. 169p. NTIS, PC A08/MF A01.

A data bank on bolter technology was assembled that included state-of-the-art industrial equipment as well as new equipment currently under development for the Bureau of Mines. This information was augmented by visits to Bureau of Mines contractors, mine operators, and others to obtain a thorough understanding of present coal mine roof bolting safety and productivity problems. Using this background material and information, a series of roof bolter concepts was developed offering improved operator safety with minimum impact on productivity. The concepts developed use existing componentry and technology wherever possible. All of the concepts feature a fully protected operator station located 6 to 10 feet outby the active bolt line and the hazardous rotating machinery.

4497 **(SAND—80-1920) European empirical methods applied to subsidence in U.S. coal fields.** Munson, D.E.; Eichfeld, W.F. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01.

The empirical methods commonly used in Europe to describe the shape of subsidence troughs are tested against the field data of the York Canyon Mine in Northern New Mexico. This

mine is in a flat lying seam under rugged terrain. The subsidence data consists of time-correlated measurements of surface displacements above two longwall panels. While the profile fits from the graphical methods (United Kingdom) do not agree with the measured profiles, the profile functions of the error integral type used in Continental Europe fit the data well. The profile function analysis of the development curves also suggests a time-dependent response of the overburden. These results, except for the specific profile function used, are similar to those found previously for longwall subsidence at the Old Ben No. 24 Mine. Parameter values of the fit, i.e., the effective half range of the function and inflection point offset, were determined for all profiles. These parameters for the development curves and traveling profiles, which fundamentally result from the same raw data, exhibit markedly different apparent "scatter." The rather narrow range of values for the development curves suggest that individual points subside in a well-behaved manner; and hence, the large variation in parameter values for the traveling profiles reflects an inadequacy in the analysis in correlation between points. Consequently, the use of influence functions appears to be a possible method for improving the empirical analysis of longwall subsidence.

4498 **(SAND—80-7059) Economic analysis of roof drill bits and continuous miner picks.** Felts, L.L.; Gabello, D.P.; Hayoz, F.P. (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Oct 1980. Contract AC04-76DP00789. 120p. NTIS, PC A07/MF A01.

The economic impact of substituting long life cutters for the tungsten carbide cutters presently used on roof bolt drill bits and continuous miner picks in underground coal mines has been analyzed. The analysis considers two room and pillar mines using continuous miners and twin boom roof bolters and one mine that employs an advanced miner-bolter extraction system. For each of these base cases, equipment lists, capitalization costs, and operating labor requirements are considered to determine mine performance in terms of cost of coal produced. Increased penetration rate was found to be of secondary importance compared to increased bit or pick life. Results are given that show tool life and tool cost required to achieve parity with tungsten carbide tools and percent savings when the long life tools exceed the parity. For example, a decrease in production costs of up to 8% is projected for mines using continuous miners and advanced technology roof bits with a 300' life.

0130 Transport And Handling

4499 **(DOE/ET/14842—T4) Coal slurry pump development: fossil energy annual summary, technical information report.** Wong, G.S. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). 30 Oct 1980. Contract AC03-79ET14842. 16p. NTIS, PC A02/MF A01.

This is a twenty-four month program on Coal Slurry Pump Development being conducted for the Department of Energy, Division of Coal Conversion, under Contract DE-AC03-79ET14842. The program consists of two phases. In the first phase an experimental prototype of a two-stage, high-pressure, centrifugal slurry pump will be fabricated and assembled into a test unit. In the second phase the experimental pump will be delivered to a DOE field test facility for initial testing in hot oil and for subsequent testing in an actual coal-oil slurry environment. During the program, Rocketdyne will supply technical support and coordination on test facility interfact requirements and for testing of the experimental pump to evaluated hydraulic, mechanical, material and operational performance characteristics.

4500 **(EPRI-CS—1517(Vol.5)) Coal preparation using magnetic separation. Volume 5. Evaluation of magnetic coal desulfurization concepts. Final report.** (Bechtel National, Inc., San Francisco, CA (USA)). Jul 1980. 188p. NTIS, PC A09/MF A01.

Magnetic separator designs performed by the four contractors under RP980 were reviewed. A complete plant-conceptual design was developed, based on high-gradient magnetic separator (HGMS) designs proposed by Sala Magnetics, Inc., and the Magnetic Corporation of America (MCA). A design for a conventional heavy medium plant was also developed and costed to establish a point of comparison for the HGMS designs. The HGMS design provided by Sala is based on their commercial operating experience in the iron ore concentration industry and operation of a one-ton/hour continuous pilot plant, while the superconducting HGMS proposed by MCA represents a conceptual design based on bench-scale data. The three plants were designed to clean 2.64 million tons/year of feed and produce approximately 2.2 million tons/year of clean coal. Also, as a part of this project, a technical review of the Magnex process (current as of 7/78), as developed by Nedlog Technology Group/Hazen Research, Inc., was performed. Results indicate that the total capital requirement for the Sala and MCA plants was $107,100,000 and $93,500,000, respectively, while the conventional heavy medium plant was $27,400,000 (mid-1978 dollars). Thirty-year levelized operating costs were $25.61/ton and $23.40/ton (based on dry, clean coal) for the HGMS plants, and $7.70/ton for the heavy medium plant.

4501 **(EPRI-EA—1549) Proceedings: workshop on coal transportation research.** Riley, R.E. (Russian Hill Associates, San Francisco, CA (USA)). Sep 1980. 54p. (CONF-800150—). NTIS, PC A04/MF A01.

From Workshop on coal transportation research; Palo Alto, CA, USA (31 Jan 1980).

This workshop presented previous and current EPRI transportation research to the utility industry and others. The proceedings consist of summaries of three presentations, a general discussion, and research recommendations. Previous transportation research at EPRI was discussed, including Coal Transportation Capability of the Existing Rail and Barge Network, 1985 and Beyond (RP437); Cost Models for Coal Transportation by Common Carrier (RP866); Domestic Oil and Gas Supply, Implications for Electricity Demand (RP944); and Fuel Transportation Analysis (RP952). Current work was described in two presentations discussing separate contracts under Transportation Network Changes and Their Effect on Energy Supply (RP1219). The consensus of this discussion was that additional research must be done to better understand the economics of coal transportation. Finally, a list of research recommendations was compiled that included projects to improve definition of rail and waterway capacity, analyze railroad cost and ratemaking procedures, develop information concerning alternative technologies such as the coal slurry pipeline, analyze impacts of legislation, and improve methodologies.

4502 **(IS—4749) Fossil energy quarterly report, April 1-June 30, 1980.** (Ames Lab., IA (USA)). Jul 1980. Contract W-7405-ENG-82. 59p. NTIS, PC A04/MF A01.

Performance testing of the Ames wet oxidation desulfurization process for removing pyrite from coal is described. Similarly the cleaning and recovery of coal brines by flotation and oil agglomeration are described. Organic sulfur compounds in coal are discussed from the behavior of the model compounds in the above processes. The possibility of selective heating of pyrite in coal by dielectric heating is described from the point of view of enhancement of the magnetic susceptibility of the pyrite. The development of an on-line system for monitoring the ash and the pyrite in the coal is described. Finally, experiments in blending coals and briquetting solvent-refined coal are described. (LTN)

4503 **(LA—8474-MS) Coal preparation waste micromineralogy.** Williams, J.M.; Elliott, N.E.; Hakkila, E.A.; Hutchinson, W.B.; Levinson, L.S.; Reiswig, R.D.; Wallace, W.O.; Wewerka, E.M.; Zelezny, W.F. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 71p. NTIS, PC A04/MF A01.

This report summarizes work conducted at the Los Alamos Scientific Laboratory on microscope and microprobe studies of coal preparation wastes from the Illinois Basin and middle Appalachia. Sample treatment techniques and probing methods are presented. Photomicrographs of the many mineral types and morphologies we observed are also presented. This document is not a treatise, but rather an attempt to present a cross section of results obtained during our investigation over a 5-year period.

4504 **(PB—80-177116) Coal preparation plant computer model. Volume I: user documentation. Final report, Jul 76-Jul 79.** Goodman, F.K.; McCreery, J.H. (Battelle Columbus Labs., OH (USA)). Jan 1980. Contract EPA-68-02-2163. 249p. NTIS, PC A11/MF A01.

The two-volume report describes a steady state modeling system that simulates the performance of coal preparation plants. The system was developed originally under the technical leadership of the U.S. Bureau of Mines and the sponsorship of the EPA. The modified form described in this report, written in Fortran, was developed by Battelle for the EPA. The original modifications made the program usable in evaluating an advanced coal cleaning facility being constructed at Homer City, PA. Subsequent changes allowed the model to be used for a wider range of performance and cost evaluations. Initial changes to the original program increased the number of process operations which could be simulated, and simplified program operation. Later modifications permitted the calculation of plant water flows and the estimation of plant costs. Volume I contains user documentation, and Volume II provides process documentation. Volume I describes the manner in which coal flows are represented, the mathematical approach of the various unit operations, the cost evaluation approach, preparation of the input, and interpretation of the output (the last two in terms of an example).

4505 **(PB—80-177124) Coal preparation plant computer model. Volume II: Program documentation. Final report, Jul 76-Jul 79.** Goodman, F.K.; McCreery, J.H. (Battelle Columbus Labs., OH (USA)). Jan 1980. Contract EPA-68-02-2163. 316p. NTIS, PC A14/MF A01.

The two-volume report describes a steady state modeling system that simulates the performance of coal preparation plants. Program documentation begins in Volume II with a discussion of basic documentation principles, followed by presentation of each routine and common block in terms of these principles.

0140 Combustion

REFER ALSO TO CITATION(S) 4428, 4486, 4525, 4757, 5131

4506 **(DOE/ET/13037—T1) Conceptual studies and preliminary design of a fluid bed fired boiler for service in an electric utility.** (Babcock and Wilcox Co., Barberton, OH (USA). Fossil Power Generation Div.). 28 Apr 1978. Contract AI01-77ET13037. 445p. NTIS, PC A19/MF A01.

As a part of this study, B and W was to develop fluid bed system design bases and parameters using any and all sources available. The design parameters used for the fluid bed boiler designs in this study were actually developed by B and W as part of their in-house AFB development program and also as a part of the subject design study. To properly carry out the assessment portion of the work it was essential to develop an understanding of the basic interrelationship of variables in order that the final comparisons would be of consistent and realistic as possible. Inputs to meet this goal were largely based on available literature, B and W experience, and engineering judgment. In some cases we also had to venture into some theoretical development work if published results appeared incomplete. The key subject areas to be covered in subsequent pages are listed: General, Fluidizing Velocity Requirements, FBC Feed Particle Size Requirements, Calculated Slip Velocities as a Function of Particle Size and Dispersed Density, Heat Transfer Equations, Heat Transfer to Horizontal Tubes in Shallow Fluidized Beds, Combustion Efficiencies, Sulfur Capture, Freeboard Performance, Distributor Plate Design, and Economic Considerations.

0150 Marketing And Economics

4507 **(DOE/TIC—11355) Transportation and market analysis of Alaska coal.** (Department of Energy, Seattle, WA (USA). Region X). Nov 1980. 220p. NTIS, PC A10/MF A01.

The United States is expected to export between 157 and 252 million short tons of coal annually by the year 2000. The development and export of Alaska coal could contribute materially to the production increases required to meet the export market. Alaska coal has several advantages over conterminous US coal reserves with respect to export trade: (1) its proximity to potential Far East markets offers transportation cost advantages; (2) large quantities of Alaska coal are located near tidewater; and (3) Alaska coal entry into the export market would displace the need for expensive and environmentally sensitive overland transportation routes that would otherwise be required to move coal from conterminous United States' fields to marine ports. This report examines the development and marketability of coal from three areas in Alaska. At each of these sites, an assessment was made of the economics of mine development, inland transportation requirements, loading facilities and overseas transportation costs. Selling prices were developed for coal at both the Alaska port and the port of entry for the potential markets. In addition, competitive coal sources (Australia, South Africa, Canada and the contiguous US) were assessed for export projections and selling price. Legal, institutional and environmental considerations of coal development in Alaska were also addressed. The study found that Alaska coal could be delivered to primary market areas (Puget Sound, Northern California, Japan, Taiwan, and Korea) for a cost of between $1.87 to $3.31 per million Btu ($28 to $53 per ton) depending on the coal source and the destination. Coal from competing countries (Canada, Australia, South Africa) can be delivered to the same markets for $33 to $45 per ton. The Far East will probably be the principal market when Alaska coal is developed.

4508 **(Ds-I—1980-3) Peat from energy use. A report from the Peat-group of the Swedish Commission for Oil Substitution.** (LiberFoerlag Allmaenna Foerlaget, Stockholm (Sweden)). 30 Jan 1980. 162p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01.

In 1979 peat was not used for energy purposes in Sweden. A few projects will start 1980 where peat is used in industrial and/or district heating applications. This report describes the peat-energy system and discusses measures to stimulate peat exploitation and the use of peat as an oil substitute. The following suggestions are made as well as retrofitting of oil boilers for wood and peat, the establishment of a price level which makes peat competititve, but profitable for exploitation, governmental funding should be raised for R and D in harvesting, dewatering, gasification, liquefaction, and environmental questions.

0160 Health And Safety

REFER ALSO TO CITATION(S) 5462, 5468, 5470, 5472, 5474

4509 **(BM-RI—8478) Controlled burnout of wasted coal on abandoned coal mine lands.** Chaiken, R.F. (Department of the Interior, Washington, DC (USA); Bureau of Mines, Washington, DC (USA)). 1980. 26p. Dept. of the Interior, Washington, D.C.

A novel approach to eliminating environmental and public safety hazards that are associated with fires in abandoned coal mines and waste banks involves the use of in situ combustion technology developed by the Federal Bureau of Mines to accelerate the burning of the wasted coals in place. This technology would be used under exhaust ventilation control conditions that would allow for total management of the hot gases produced. Combustion stoichiometries would be optimized to minimize unburnt combustibles and to maximize the heat content of the gas products, which will be exhausted at one or more fan locations. When necessary, scrubber systems would be employed to remove air pollutants, such as sulfur dioxide; heat utilization systems (process heat, steam, and electricity) would also be employed to offset operational costs. Ultimately, complete burnout would solve the fire and acid water formation problems of the abandoned coal mine or waste bank. Pertinent technical data for burnout control are derived and discussed in terms of the important material and operational parameters. In general, it is believed feasible to operate a burnout system in an existing abandoned mine or waste bank fire at thermal power levels in the range of 10 to 100 MW, and at exhaust gas temperatures of 1000°C (1830°F).

02 PETROLEUM

0202 Geology And Exploration

4510 Basic oil and gas technology for Lawyers and Landmen Institute. Boulder, Colorado; University of Colorado (1979). 224p. (CONF-7904153—).

From Basic oil and gas technology for lawyers and landmen institute; Denver, CO, USA (3 Apr 1979).

The texts are presented from lectures on petroleum and natural gas technologies which would be helpful to persons involved financially or legally with these industries. Basic petroleum geology, basic operational engineering (drilling, completions, perforating, equipment, acidizing, hydraulic fracturing, testing gas wells), well logging, reservoir engineering, and practical applications are included.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 4510, 4914

4511 (DOE/BC/20006—18) Single-well chemical tracer method for measuring residual oil saturation. Final report. Deans, H.A.; Majoros, S. (Rice Univ., Houston, TX (USA)). Oct 1980. Contract AS19-79BC20006. 202p. NTIS, PC A10/MF A01.

A number of significant advances in the theory of the single-well chemical tracer method for measuring residual oil saturation (S/sub OR/) are reported. Particularly important is the theoretical basis for optimizing test design to obtain maximum sensitivity to S/sub OR/. Quantitative results are presented for the first time on the effects of fluid drift, flow irreversibility, stratification, and mobile oil. The results of 59 single-well tracer tests which were compiled during this study are presented. These data were donated by the licensees of Exxon Production Research Co., who originated the method. The tests are reviewed with respect to optimal design and field procedures established here. The available techniques for measuring the tracer distribution coefficients (K-values) which are required to obtain S/sub OR/ from the field data are described. Correlations are presented for predicting the K-values for ethyl acetate and propyl formate, two of the most commonly used chemical tracers. Several techniques for obtaining S/sub OR/ from the field-measured tracer concentration profiles are reviewed. The most difficult procedure, detailed simulation using proprietary computer programs, has been used to obtain acceptable interpretations in over 80% of the reported tests.

4512 (DOE/ET/12086—1) Lynch Canyon combination thermal drive project. Stair, J.R. (Mobil-GC Corp., Newport Beach, CA (USA)). Nov 1980. Contract AC03-78ET12086. 95p. NTIS, PC A05/MF A01.

The following report provides a summary of the Lynch Canyon Thermal Drive Project. This demonstration project was begun in 1978 and terminated in 1980. The project originally was divided into four phases; Geologic Evaluation, Injectivity Test, Field Development Combined with Air-Water Injection, and a Project Review. Following the First Phase operations, which included drilling of four wells for geologic evaluation, a joint decision to cancel the project was made. The conditions which were thought to exist at the initiation of the project, would have provided an excellent opportunity to conduct a Pilot Combination Thermal Drive. However, potential problems which were discovered in the Phase One Operations significantly altered the economics of the project and removed the favorable conditions under which the project was begun.

4513 (DOE/ET/14317—T3) Report of the workshop on Arctic oil and gas recovery. Sackinger, W.M. (ed.). (Alaska Univ., Fairbanks (USA). Geophysical Inst.). Sep 1980. Contract AC01-80ET14317. 54p. NTIS, PC A04/MF A01.

Mission of the workshop was to identify research priorities for the technology related to Arctic offshore oil and gas production. Two working groups were formed on ice-related subjects and soil-related subjects. Instrumentation needed to accomplish some of the research objectives was also discussed. Results of a research priority allocation survey are summarized. (DLC)

4514 (DOE/MC/11284—T4) Synthesis of polysulfonates for enhanced oil recovery by chemical flooding. Final report, 20 August 1979-14 August 1980. Muth, C.W. (West Virginia Univ., Morgantown (USA)). Oct 1980. Contract AT21-79MC11284. 36p. NTIS, PC A03/MF A01.

Synthetic studies have been conducted on di- and trisulfonates of diphenylalkanes which may be the enhanced oil recovery (EOR) agents in commercial alkylbenzenesulfonates. Nine di- and trisulfonates of diphenylalkanes have been made and none has much EOR activity as the active fractions of commercial alkylbenzenesulfonates. Texas 2 (sulfonate of 5-(p-ethylphenyl) dodecane) has good EOR activity but Texas 2 has low solubility in brine. Structure modifications of Texas 2 led to compounds with less EOR activity than Texas 2 has. Removal of the para ethyl group from Texas gave a compound with no EOR activity as did the shortening of the longer alkyl group from 12 to 8 carbons. Replacing the ethyl group of Texas 2 with hydroxy and subsequent sulfonation yielded a sparingly brine soluble product with low EOR activity. Preliminary infrared and nuclear magnetic resonance studies of the methyl esters of EOR activity fractions of commercial alkylbenzenesulfonates (NBS and N5B) indicate that the active fractions are mixtures of p-alkylbenzenesulfonates.

4515 (DOE/SF/01802—21) Pilot demonstration: enhanced oil recovery by micellar-polymer waterflooding, Bell Creek Field. Quarterly technical progress report, January-March 1978. (Gary Operating Co., Englewood, CO (USA)). 15 Apr 1978. Contract AC03-78SF01802. 100p. NTIS, PC A05/MF A01.

The continuing work undertaken by Gary Operating Company, as well as by the major subcontractors, Union Oil Company and Intercomp, is covered. The progress to date is given for: Micellar-Polymer Systems Selection and Evaluation, Site Development, Pilot Performance Predictions and Fluid Distribution Facilities, Fluid Injection Schedule and Production Monitoring.

4516 (UCRL—83444) Fluid-flow monitoring using electromagnetic probing. Lytle, R.J.; Lager, D.L.; Laine, E.F.; Salisbury, J.D.; Okada, J.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Oct 1979. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01.

High-frequency electromagnetic probing is used to monitor the rate and direction of flow of fluids injected into the ground. This method shows the potential for providing more detailed information than procedures presently used. The experimental technique and the test-of-concept experimental results are discussed. This technique has applications in oil-reservoir engineering and in hydrology studies concerning storage of chemical and nuclear wastes. 11 figures.

0205 Products And By-products

REFER ALSO TO CITATION(S) 5022

4517 Aviation fuel prospects. Goodger, E.M. (Cranfield Inst. of Tech., Bedford, England). pp 200-215 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

Although the world-wide availability of petroleum-based jet fuels is likely to endure for several years, the less attractive crudes will eventually have to be accepted by the refinery, together with the hydrogenation of heavy fractions. Fuel supplies may then be supplemented by heavier, more broadly specified, kerosenes derived from shale, tar and coal, provided the higher freezing points and aromatic contents can be handled satisfactorily. If necessary, hydrocarbon fuels could be synthesized from inorganic hydrogen and carbon, with an overall loss in energy. Liquid hydrogen appears to be the ultimate in chemical fuels, offering substantial advantages with a relatively few, although significant, handling problems. From time to time, interest revives in the concept of nuclear pro-

pulsion for aircraft which, provided crash safety can be realized, would offer almost unlimited range. In view of the long lead time inherent in any major technological development, it would seem essential to make an urgent detailed study of all the likely fuel options for the aviation sector, as part of an overall energy plan, and to balance as wisely as possible the conflicting needs to maintain a flexible approach and yet make firm decisions without delay.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 4941

4518 **(DOE/ET/10246—T1) End of survey report price, deliveries and stocks of heating oil: State of Oregon, 1979-1980.** Falotico, R.R. (Portland State Univ., OR (USA)). 16 May 1980. Contract FG01-77ET10246. 25p. NTIS, PC A02/MF A01.

This report includes the following: method used in conducting the survey of price, deliveries and stocks of heating oil; specific affecting factors, weather, price increases and availability; recommendations; and data acquired from dealers for the periods October 29, 1979 to March 31, 1980.

4519 **(DOE/PE—0021) Reducing US oil vulnerability: energy policy for the 1980's.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Policy and Evaluation). 10 Nov 1980. 40p. NTIS, PC A03/MF A01.

This study assesses current Federal energy policies and programs in light of recent events and in light of what are believed to be the most reliable available projections of the future. Then it outlines additional steps - some unpleasant - that could reduce our vulnerability to an oil import disruption during the next decade. Specifically, the study seeks to answer three questions: (1) as a base case, what levels of US energy consumption, production, and imports might we anticipate for 1985 and 1990 under existing statutes, policies, and programs; (2) considering both our own and our allies' dependence on oil imports, how vulnerable does this leave the United States to foreign supply disruptions; (3) considering the likely effects of government policies and programs which already exist to reduce our vulnerability (through reduction of US oil imports or by any other means), are there additional initiatives that could be undertaken to give us greater protection - especially between now and 1990.

4520 **(LBL—10583) Custody/ownership dichotomies in the U.S. petroleum supply system.** Cahn, D.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01.

Problems encountered in tracing petroleum ownership and custodial holdings simultaneously are discussed. Methods for data collection for both custody and ownership domains are described. Ownership/custody must be established by federal agencies which use petroleum data for monitoring (allocations) and intervention (compliance).

4521 **Disaggregated analysis of petroleum supply: a useful vehicle for policy analysis.** Ball, B. Jr.; Houghton, J.; Kaufman, G. (Massachusetts Inst. of Technology, Cambridge). pp 537-561 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

Most nationwide energy-policy studies are based on highly aggregated energy-mineral-supply forecasts. More-precise and reliable disaggregated projections are available only for a few metallogenic and petroleum provinces. No such projections are available for use in forecasting total US supply as a function of policy choice. Disaggregated supply modeling requires extensive data, substantial geologic and engineering expertise, and is computationally expensive. Methods universally applicable to the wide variety of specific geologic units and to the varying levels of knowledge about each unit have not been developed. To become applicable for this broad usage, disaggregated representations must be constructed so that the model of each of the units can be summed, with internal consistency and appropriate interactions. A central objective of future research is the achievement of logical consistency between projections based on entirely different levels of available data, across different geological units, and over different time frames. (MCW)

0209 Environmental Aspects

4522 **(IVL-B—537) Dispersal and effects of the Antonio Gramsci oil spill in the Stockholm archipelago.** Notini, M.; Mattsson, J.; Linden, O. (Institutet foer Vatten- och Luftvaardsforskning, Fryksta (Sweden)). Feb 1980. 32p. (In Swedish). NTIS, PC A03/MF A01.

In February 1979 the Russian tanker Antonio Gramsci grounded outside Lettland; 6000 tons of oil were spread in the Baltic. A part of this was passed to the Swedish coast by easterly winds. Effects of the oil have been studied. The greatest effects were observed on organisms living by the seashore, especially crustaceans, which were in direct contact with the oil. The oil had been in the water quite a long time before it reached the Swedish coast. The most poisoning components (volatile aromatics) were not present, and the effects were limited. In some places cleaning caused damages because of the steam used. Fish from the area contained more oil than normal. In mussels there was no excess oil.

4523 **(IVL-B—538) Effects of chronical oil pollution outside a refinery in the Northern Baltic.** Mattsson, J.; Linden, O.; Lundberg, S.; Notini, M. (Institutet foer Vatten- och Luftvaardsforskning, Fryksta (Sweden)). Feb 1980. 22p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01.

The area influenced by the petroleum refinery at Nynaeshamn south of Stockholm, Sweden, has been investigated are used. The content of petroleum hydrocarbons has been analysed in sediments, mussels, and fishes. Samples from the rockweed area and from the deeper areas with soft seafloor. The analysis showed that samples from a big area contained excess petroleum hydrocarbons. In the rockweed area no effect on the Fauna could be proved. In the soft seafloor area it was noted that the number of living organisms was considerably reduced.

4524 **(IVL-B—549) Contents and long time effects in the littoral zone after an oil spill. A two year study of the Tsesis oil spill.** Notini, M. (Institutet foer Vatten- och Luftvaardsforskning, Fryksta (Sweden)). Mar 1980. 16p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01.

In 1977 a Russian tanker, Tsesis, grounded in the archipelago south of Stockholm, Sweden. 1000 tons of oil were spread in the sea. 400 tons were left in the environment after cleaning. The oil has caused considerable acute damage to the Fauna on the seashore. The balance between different species has been disturbed. During the two years following the oil spill the difference from the situation immediately before the accident has been greater as time has passed. The population of crustaceans has increased five times, while the population of molluscs (especially Theodoxus) decreased to a 10th. The content of aromatic and aliphatic substances in mussels increased rapidly after the oil spill, and has since then decreased slowly to the normal value.

0250 Combustion

REFER ALSO TO CITATION(S) 4945, 5009, 5010

4525 **Role of fluidized bed combustion in the efficient use of petroleum.** Moss, G. (Esso Research Centre, Oxfordshire, England). pp 81-92 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

Fluidized bed combustion can help to ensure the efficient utilization of petroleum in two ways, by providing a non-polluting outlet for the interactable petroleum residues produced by refining techniques which minimize fuel oil production, and by allowing coal to be substituted for the petroleum normally consumed as

process fuel within oil refineries. Both of these possibilities imply the use of relatively large scale fluidized bed combustors running at relatively high load factors and probably at atmospheric pressure. There is a third, indirect application, which would allow petroleum pitch or coal to be substituted for the distillate oil or natural gas used to operate power generating gas turbines, and no account of the work in progress on fluidized bed combustion would be complete without some reference to pressurized applications. Although the favorable heat transfer properties of fluidized beds are sometimes cited as justification for the development of fluidized bed boilers, it is the pollution control potential of fluidized bed combustion which provides the main driving force for their development. This paper describes the way emission of both oxides of nitrogen and sulfur are controlled in fluidized bed combustion, and describes in detail the atmospheric pressure systems, and pressurized systems of fluidized bed combustion.

03 NATURAL GAS

0301 Reserves

4526 (LA—8568-PR) Methane hydrate resource assessment program. Progress report, April-June 1980. Barraclough, B.L. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 29p. NTIS, PC A03/MF A01.

This is the first quarterly report describing progress at the Los Alamos Scientific Laboratory on a program to study the nature, occurrence, and resource potential of methane (natural gas) hydrates. Several options are discussed for fielding an experimental program in the North American arctic, in conjunction with ongoing operations. Analysis indicates that a cooperative program involving DOE/LASL, the Canadian government, and Panarctic Oils, Ltd., fielded at a drilling site in the Canadian Arctic Islands, probably offers the greatest probability of overall program success. A comprehensive series of away-from-hole (remote), downhole, and core measurements, to be performed at a site determined to be underlain with hydrates, is outlined. Objectives and progress of a laboratory effort to study synthetic hydrates are briefly described. A preliminary energy-balance-type analysis of hydrate formation stimulation by hot fluid injection, indicates significant, but probably uneconomic (for the arctic), rates of natural gas production might be feasible.

0302 Geology And Exploration

4527 (ANL/ES—87) Reconnaissance survey for lightweight and carbon tetrachloride extractable hydrocarbons in the central and eastern basins of Lake Erie: September 1978. Zapotosky, J.E.; White, W.S. (Argonne National Lab., IL (USA)). Oct 1980. Contract W-31-109-ENG-38. 160p. NTIS, PC A08/MF A01.

A reconnaissance survey of the central and eastern basins of Lake Erie (22,240 km^2) was conducted from September 17 to 27, 1978. The survey provided baseline information on natural gas and oil losses from geologic formations, prior to any potential development of natural gas resources beneath the United States portion of the Lake. Lightweight hydrocarbons indicative of natural gas (methane, ethane, propane, isobutane, and n-butane) are introduced into the waters of Lake Erie by escape from geologic formations and by biological/photochemical processes. The geochemical exploration technique of hydrocarbon sniffing provided enough data to reveal significant distribution patterns, approximate concentrations, and potential sources. Twelve sites with elevated lightweight hydrocarbon concentrations had a composition similar to natural gas. In one area of natural gas input, data analysis suggested a potential negative effect of natural gas on phytoplanktonic metabolism (i.e., ethylene concentration). Samples taken for liquid hydrocarbon analysis (carbon tetrachloride extractable hydrocarbons) correlated best with biologically derived lightweight hydrocarbons.

4528 (MLM-MU—80-71-0007) Physical and chemical characterization of Devonian gas shale. Quarterly status report, July 1, 1980-September 30, 1980. Zielinski, R.E.; Moteff, J.D. (Monsanto Research Corp., Miamisburg, OH (USA)). 1980. 127p. (MLM-EGSP-TPR-Q—015). NTIS, PC A07/MF A01.

Data were obtained from wells located in Pennsylvania, Kentucky, New York, Virginia, West Virginia, Ohio, Tennessee, Illinois, and Indiana. Geochemical data relevant to estimating the potential hydrocarbon generation from Devonian gas shales are presented. Organic carbon content, kerogen assessments, vitrinite reflectance, and kerogen elemental composition were determined. Lithological descriptions are included. (DMC)

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 4510, 4513

4529 (DOE/METC/SP—80/22) Semi-annual report for the unconventional gas recovery program, period ending September 30, 1980. Manilla, R.D. (ed.). (Department o Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Nov 1980. 370p. NTIS, PC A16/MI A01.

Progress is reported in research on methane recovery from coalbeds, eastern gas shales, western gas sands, and geopressured aquifers. In the methane from coalbeds project, data on information evaluation and management, resource and site assessment and characterization, model development, instrumentation, basic research, and production technology development are reported. In the methane from eastern gas shales project, data on resource characterization and inventory, extraction technology, and technology testing and verification are presented. In the western gas sands project, data on resource assessments, field tests and demonstrations and project management are reported. In the methane from geopressured aquifers project, data on resource assessment, supporting research, field tests and demonstrations, and technology transfer are reported.

4530 (UCID—18860) Evaluation of geopressured brine injectability: Department of Energy, Pleasant Bayou No. 2 well, Brazoria County, Texas. Owen, L.B.; Blair, C.K.; Harrar, J.E.; Netherton, R. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 28 Oct 1980. Contract W-7405-ENG-48. 92p. NTIS, PC A05/MF A01.

A field evaluation of geopressured brine injectability was completed during September 22 to 25, 1980 at the DOE, Brazoria test site in Texas. Membrane filters, with pore sizes of 0.4-μm and 10.0-μm, were used as the basis for obtaining suspended solids data and for developing performance-life estimates of typical spent brine injection wells. Field measurements were made at 130°C and line pressures up to 3800 psig. Scale inhibited (phosphonate-polyacrylate threshold-type, carbonate scale inhibitor), prefiltered-scale-inhibited, and untreated brine were evaluated. Test results indicated that raw brine was highly injectable, while scale-inhibited brine had extremely low quality. The poor injectability of scale-inhibited brine resulted from partial precipitation of the scale inhibitor.

0305 Health And Safety

4531 (NTSB-PAR—80-2) Pipeline accident report: Columbia Liquified Natural Gas Corporation Explosion and Fire, Cove Point, Maryland, October 6, 1979. (National Transportation Safety Board, Washington, DC (USA). Bureau of Accident Investigation). 16 Apr 1980. 39p. NTIS.

About 3:35 a.m., e.d.t., an explosion caused by liquefied natural gas vapors destroyed a transformer building at the reception facility of the Columbia LNG Corporation, Cove Point, Maryland. Odorless liquefied natural gas leaked through an inadequately tightened LNG pump seal, vaporized, passed through approximately 210 ft of underground electrical conduit, and entered the substation building. One person was killed and one person was seriously injured. Damage to the facility was estimated at about $3 million. The National Transportation Safety Board determines that the probable cause of the accident was LNG which leaked through an

inadequately tightened LNG pump seal, vaporized, and migrated through a 3-in. conduit, into a substation building where the vaporized LNG-air mixture was ignited by the arcing contacts of a circuit breaker interlock. Contributing to the accident was the absence of any combustible gas indicator to detect and warn personnel of the presence of flammable vapors in the building.

0306 Marketing And Economics

4532 **(PB—80-173552) Alternative energy futures. Part I: the future of liquefied natural gas imports.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Mar 1980. 133p. NTIS, PC A07/MF A01.

This assessment is in response to a request by the Senate Committee on Finance for an evaluation of the economic and energy implications of any future liquefied natural gas imports. Included in the study are: a discussion of worldwide availability of natural gas for U.S. import as LNG in the context of projected U.S. gas demand, alternative North American oil and gas resources, and the security of foreign supplies. The report also includes sections on LNG project structure, cost, and financing with observations about balance-of-payment impacts and public exposure to financial risk. An analysis of the behavior of gas markets in determining who receives additional supplies by virtue of LNG projects, and who pays for them, illustrates some of the practical effects of the Natural Gas Policy Act of 1978.

0309 Artificial Stimulation

4533 **(DOE/ET/12150—1) Massive hydraulic fracture test Cotton Valley Lime East Texas. Final report, 8 August 1978-31 July 1980.** Kozik, H.G.; Holditch, S.A.; Kumar, A. (Mitchell Energy Corp., The Woodlands, TX (USA)). Aug 1980. Contract AC08-78ET12150. 70p. NTIS, PC A04/MF A01.

This report summarizes the results of an active stimulation program on the Cotton Valley Lime as evaluated using reservoir production and pressure transient data. Using standard economic parameters and reservoir permeabilities determined by history matching, a detailed study was made to determine the well spacing and fracture length radius necessary for optimum development of the Fallon and North Personville Fields. In addition, the major details of designing and executing a super massive hydraulic fracture job are discussed in the appendix.

4534 **(UCRL—50036-80-1) LLNL gas stimulation program. Quarterly progress report, January-March 1980.** Hanson, M.E.; Anderson, G.D.; shaffer, R.J.; Towse, D.F.; Lin, W.; Cleary, M.P.; Peterson, D.R.; Wong, S.K.; Haimson, B.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 May 1980. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01.

This report summarizes the research and accomplishments of the LLNL Gas Stimulation Program during the second quarter of FY 1980. We have continued to analyze the effects of dynamics and fractures on hydraulic fracture propagation near interfaces. We have also begun some analysis of the propagation of penny-shaped cracks including an averaged flow description in the cracks. Poiseuille flow descriptions of Newtonian fluids were used to model the fluid flow and pressure distribution in the crack. Frictional effects and measurements were emphasized in the laboratory experiments. These results show that variation in friction along an interface can result in abrupt steps in the fracture path. We have also completed a laboratory study of the effects of fluid viscosity on fracture orientation under various stress states. Results from these experiments indicate that the fluid viscosity does not significantly affect the fracture orientation; however, increases in fluid viscosity result in higher breakdown pressures. We have continued to study the relation between natural fractures and structural geology in the Piceance Basin.

0350 Storage

4535 **(STU—75-4891) LNG in rock. A new storage option.** Lindblom, U. (Hagconsult AB, Stockholm (Sweden)). Jun 1978. 83p. NTIS, (US Sales Only), PC A05/MF A01.

The special grouting system for thermal cracks makes it possible to create storagen space in blasted rock caverns. Underground cryogen storage is a complicated rock mechanics problem. Safety measures against LNG-rock contact must be taken. The new concept includes drillholes which are pressurized with a grout material that solidifies near -100°C. Fractures will successively become filled with grout. Another storage option is to vaporize and compress the gas into large storage chambers at great depth. Economic comparison with surface tanks is made. The research and development work included coupled thermomechanical finite element analysis for modelling thermal crack formation and rock mechanics research on low temperature values for Young's modulus, Poisson's ratio, thermal expansivity coefficient and uniaxial compressive strength. Cylindrical specimens of limestone, sandstone and granite were investigated. Also, the influence of uniaxial stress on the rock mechanics parameters was studied. Increase of stiffness and strength at temperatures far below 0°C is believed to be explained by the progressive solidification of mobile water in the rock matrix. Recorded thermal expansions of rock cylinders due to cooling below -90°C are believed to be caused also by volume and shape changes of mineral crystals. Laboratory experiments on selected grout materials were accomplished in cooled capillary tubes. Grouting was also demonstrated to be effective in sealing thermal cracks in granite. Underground storage of LNG has some distinct advantages that now need more attention.

04 OIL SHALES AND TAR SANDS

0401 Reserves And Exploration

REFER ALSO TO CITATION(S) 4541

0403 Drilling, Fracturing, And Mining

4536 **(SAND—78-1886) Instrumentation and evaluation of the Talley Energy Systems, Inc. oil shale project. Part II. Explosive insertion, detonation and post-shot evaluation results.** Beasley, R.R.; Boade, R.R. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 86p. NTIS, PC A05/MF A01.

January 1979 marked the completion of Phase I of the Talley Energy Systems, Inc. (TESI) contract with the Department of Energy (DOE) which was undertaken to examine the hydraulic/explosive fracturing method for preparing an underground oil shale bed for true in situ processing. Phase I of the contract involved the bed preparation activities - specifically the creation of four horizontal hydrofractures in the shale bed, the insertion and subsequent detonation of slurry explosives in these hydrofractures, and the detailed assessments of major operations and of the rock formation before and after these operations. Phase II of the contract, which was cancelled, was to have been a retorting operation. Sandia National Laboratoy participated in the TESI experiment by providing instrumentation and technical support in several areas during Phase I. This report described the work performed during the explosive insertion and detonation operations and during the post-shot evaluation. The results of the various measurements performed during these operations are discussed along with an overall assessment of the post-shot state of the formation.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 4475

4537 (DOE/LC/10036—T5) Occidental vertical modified in situ process for the recovery of oil from oil shale: Phase II. Quarterly progress report, June 1, 1980-August 31, 1980. (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Sep 1980. Contract FC20-79LC10036. 315p. NTIS, PC A14/MF A01.

The major activities at OOSI's Logan Wash site during the quarter were: mining the voids at all levels for Retorts 7, 8 and 8x; completing Mini-Retort (MR) construction; continuing surface facility construction; tracer testing the MR's; conducting Retorts 7 and 8 related Rock Fragmentation tests; setting up and debugging the Sandia B-61 trailer; and preparing the Phase II instrumentation plan. In addition, the letter reports from the US Bureau of Mines for oil shale samples taken during Phase I which are included in one of the appendices.

4538 (DOE/LC/10036—T5) Occidental vertical modified in situ process for the recovery of oil from oil shale. Phase II. Annual progress report, June 1, 1979-May 31, 1980. (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Aug 1980. Contract FC20-79LC10036. 575p. NTIS, PC A24/MF A01.

Objective of Phase II is the technical feasibility demonstration of Occidental Oil Shale Inc's vertical modified in situ oil shale retorting process. The major activities at Logan Wash and on Phase II from June 1, 1979 through May 31, 1980 were: driving the access and ventilation drifts toward the underground location for Retorts 7 and 8; retort void mining; raise boring, surface facility construction; mining the rooms for and forming three of the Mini-Retorts (MR's); MR construction; change house construction and developing an instrumentation program under DOE funding with DOE and Sandia Laboratories. Documentation of the instrumentation plan for all areas of Phase II was started in May, 1980.

4539 (UCRL—52930) Solar retorting of oil shale. Gregg, D.W.; Taylor, R.W.; Grens, J.Z.; Aiman, W.R.; Marsh, L.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 May 1980. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01.

First, in an overview, we outline and discuss the potential applications of solar energy to the production of fuels. We show that, starting from a fossil feedstock, there are four areas in which solar energy can have a major impact in the production of fuels: in solar retorting of oil shale, in solar coal gasification, in solar steam flooding of oil fields, and in solar steam-reforming of methane. We performed a detailed technical and economic analysis of solar retorting of oil shale. The analysis shows that this solar process not only should be technically feasible but also should improve the fuel yield from the oil-shale feedstock by 10 to 40%, depending on the grade of the shale, compared to the most efficient competing (non-solar) process. The improved oil yield should more than pay for the incremental cost associated with adding the solar collection system (field of focusing heliostats). The results from an experiment in which solar energy was used to retort oil shale show that yields of better than 110% Fischer Assay are achievable. An advanced design for a solar oil-shale retort is also presented.

4540 Radio-frequency energy may extract tar sand oil. *USAutomotive Engineering (New York) (U.S.)Supersedes SAE (Soc. Automot. Eng.) J.;* **88**: No. 1, 80-83(Jan 1980).

Investigators at Illinois Institute of Technology's Research Institute (IITRI) are extending an electrical method for in situ extraction of bitumen from tar sands to a previously unexplored radio frequency (RF) range. Small-scale tests and calculations promise good recoveries with reasonable expenditures of both money and energy. A major difficulty in recovering bitumen and heavy oils has been their high viscosity under native conditions. Past in situ methods have encountered financial and environmental problems, principally because of the deposits' poor thermal conductivity and near impermeability to fluids. IITRI has overcome the heat transfer problem by inventing an efficient RF power deposition technology suitable for heating very large in situ tar sand volumes without depending on thermal conduction or convection. Special patterns of tubular conductors are inserted in bore holes, and RF energy is applied at a frequency tailored to the electrical characteristics of the heated resource. Choice of the frequency and proper conductor pattern insures that virtually all applied RF power is contained, and does not leak out to cause interference problems.

0405 Properties And Composition

4541 Influence of shale conductivities on the electrical conductivity of low-permeability rocks. Volk, L.J.; Raible, C.J.; Carroll, H.B. (US DOE). *USJournal of Petroleum Technology (U.S.);* **32**: No. 5, 865-867(May 1980).

This article briefly reports on an evaluation of the Waxman and Smits (W-S) model and the dual water (D-W) model of Clavier et al. for explaining the conductivity of shaly formations when the data are based on the potassium counterion instead of the sodium counterion, as normally done. The electrical effects of shaliness were measured on cores from the Mesaverde group of the Uinta and Piceance basins, and the data were used in the two models. 6 refs.

4542 Effects of strain rate on oil shale fracturing. Chong, K.P.; Hoyt, P.M.; Smith, J.W.; Paulsen, B.Y. (Univ of Wyo, Laramie). *USInternational Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts (U S.)Supersedes International Journal of Rock Mechanics and Mining Sciences;* **17**: No. 1, 35-43(Feb 1980).

Uniaxial testing of oil shale from the Green River Formation in Wyoming indicates that the compressive fracturing strength is strongly dependent on organic volume and on strain-rate. Failure modes ranged from brittle for lean samples to ductile for rich ones. A strain-rate dependency failure mechanism is presented. Data from stress and strain measurements together with combustion analysis data for organic volume were used in multiple regression computer programs to demonstrate correlation between ultimate compressive stresses, strain-rate, and oil shale composition. A linear relationship was observed among the ultimate stress, organic volume, and the logarithmic strain-rate. The linear relationship enables the ultimate stress to be extrapolated at the explosive strain-rates for different oil yields with confidence. 19 refs.

0407 Health And Safety

REFER ALSO TO CITATION(S) 5472

0409 Waste Research And Management

4543 (LBL—10746) Spent shale as a control technology for oil shale retort water. Annual report, October 1, 1978 - September 30, 1979. Fox, J.P.; Jackson, D.E.; Sakaji, R.H.; Daughton, C.G.; Selleck, R.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1980. Contract W-7405-ENG-48. 105p. NTIS, PC A06/MF A01.

This program is investigating two potential uses of the spent shale for treatment of retort waters. In the first application, the abandoned in-situ retorts would be directly used as part of a treatment system. Water generated in one retort would be circulated through spent shale in an adjacent retort to reduce contaminants in the water and to cool the in-situ spent shale in preparation for retort abandonment and grouting. In the second application, spent shale produced in surface retorts would be used in packed columns similar to powdered activated carbon columns. The exhausted spent shale would be disposed of along with other solid wastes in the on-site solid waste disposal facility. The work summarized here indicated that spent shales are effective in removing color, odor, inorganic carbon, and certain classes of organic compounds, and in elevating the pH of retort water and gas condensates so that NH_3 may be readily stripped.

0410 Enviromental Aspects

4544 (LA—8378) Integrated environmental control technology approach to oil shale commercialization. Peterson, E.J.; Thode, E.F.; Wagner, P.; Wanek, P.L. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 24p. NTIS, PC A02/MF A01.

A literature search was conducted to evaluate information about the chemistry, behavior, and distribution of environmentally hazardous water contaminants produced during extraction (above and below ground) and upgrading of shale oil, and to assess research in oil shale environmental control technology. This report details the literature pertinent to environmental control technology research. Air quality, water quality, potential surface disruption, and potential problem areas are assessed, research needs are identified, and where applicable, environmental control technologies and future research areas are indicated.

4545 **(LBL—8780) Control strategies for abandoned in-situ oil shale retorts.** Persoff, P.; Fox, J.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 110p. NTIS, PC A06/MF A01.

Prevention of groundwater pollution resulting from in-situ oil shale development will require a novel control technology. Based upon information available regarding the problems and related technologies, certain candidate control technologies appear technically and economically feasible. These technologies and their projected costs are listed. Pending verification of certain assumptions, it appears possible to prevent pollution of groundwater for about $0.59 to $0.67 per barrel by recovering leachate and treating it on the surface; for about $0.74 to $2.85 per barrel by placing a grout curtain around an entire block of retorts; or for about $0.35 to $1.30 per barrel by backfilling abandoned retorts with a grout of surface-retorted spent shale. These cost projections are preliminary and subject to change as experimental data are generated and as design criteria are developed. The technical feasibility of these technologies has not been demonstrated, and many uncertainties remain concerning technologies as well as site-specific issues. Therefore, these cost projections are initial approximations which may not reflect actual costs at any specific site. Nevertheless, the projections are useful for RD and D decision-making. Detailed cost projections for each control technology are provided in this study.

05 NUCLEAR FUELS

0501 Reserves

4546 **(GJBX—215(80)) Study of drill core from the East Chaco Canyon area, San Juan Basin. Part I. Geochemical studies.** Brookins, D.G. (New Mexico Univ., Albuquerque (USA). Dept. of Geology). Sep 1979. Contract AC13-76GJ01664. 236p. NTIS, PC A11/MF A01.

The East Chaco Canyon (ECC) drilling program was undertaken by the US Department of Energy (DOE) to compare the Westwater Canyon Member of the Morrison Formation from the ECC part of the San Juan Basin with the highly uranium mineralized Westwater Canyon Member of the Grants Mineral Belt (GMB). Core from fifteen DOE drill holes was made available in part as drilling had been completed, in part as drilling progressed, and in part after the drilling program had been terminated. Proper E-logs to assist in spotting the upper and lower contacts of the Westwater Canyon Member from the ECC samples were made available in summer 1979. Some 70 samples were selected for thin section examination for their sedimentary petrology/petrography; separate aliquots of these were selected for clay mineralogic and geochemical study. Due to logistical problems of reactor time, access to counting facilities, lack of sample containers for chemical work, and other factors, only eighty of ninety samples originally selected for study were completed. The data are shown. The other tasks of the work statement have been completed on schedule and are discussed.

0502 Exploration

4547 **(GJBX—238(80)(Pt.1)) Hydrogeochemical and stream sediment detailed geochemical survey for Thomas Range-Wasatch, Utah.** Butz, T.R.; Bard, C.S.; Witt, D.A.; Helgerson, R.N.; Grimes, J.G.; Pritz, P.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Aug 1980. Contract AC13-76GJ01664. 210p. (K/UR—35(Pt.1)). NTIS, PC E07/MF$3.50.

Includes 1 sheet of 48 reduction microfiche.

Results of the Thomas Range-Sheeprock Mountain project area of the Thomas Range-Wasatch detailed geochemical survey are reported. Field and laboratory data are presented for 564 stream sediment samples and 128 radiometric readings. Statistical and areal distributions of uranium and possible uranium-related variables are given. A generalized geologic map of the project area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Soluble uranium concentrations (U-FL) in stream sediments range from 1.36 to 44.85 ppM. Total uranium concentrations (U-NT) range from 2.10 to 49.00 ppM. Thorium concentrations range from <2 to 148 ppM. Uranium and thorium are concentrated in two areas: (1) the Thomas Range-Spor Mountain area (including Topaz Mountain), and (2) the Sheeprock Mountain area. Associated variables in the Thomas Range-Spor Mountain area are beryllium, lithium, potassium, sodium, niobium, and yttrium. Associated variables in the Sheeprock Mountain area are beryllium, niobium, selenium, yttrium, and zinc.

4548 **(GJBX—238(80)(Pt.2)) Hydrogeochemical and stream sediment detailed geochemical survey for Thomas Range-Wasatch, Utah. Farmington Project area.** Butz, T.R.; Bard, C.S.; Witt, D.A.; Helgerson, R.N.; Grimes, J.G.; Pritz, P.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Aug 1980. Contract AC13-76GJ01664. 375p. (K/UR—35(Pt.2)). NTIS, PC E12/MF$3.50.

Includes 1 sheet of 48 reduction microfiche.

Results of the Farmington project area of the Thomas Range-Wasatch detailed geochemical survey are reported. Field and laboratory data are presented for 71 groundwater samples, 345 stream sediment samples, and 178 radiometric readings. Statistical and areal distributions of uranium and possible uranium-related variables are given. A generalized geologic map of the project area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Uranium concentrations in groundwater range from <0.20 to 21.77 ppB. The highest values are from groundwaters producing from areas in or near the Norwood Tuff and Wasatch, Evanston, and/or Echo Canyon Formations, and the Farmington Canyon Complex. The uranium:boron ratio delineates an anomalous trend associated with the Farmington Canyon Complex. Variables associated with uranium in groundwaters producing from the Norwood Tuff and Wasatch, Evanston, and/or Echo Canyon Formations include the uranium:sulfate ratio, boron, barium, potassium, lithium, silicon, chloride, selenium, and vanadium. Soluble uranium concentrations (U-FL) in stream sediments range from 0.99 to 86.41 ppM. Total uranium concentrations (U-NT) range from 1.60 to 92.40 ppM. Thorium concentrations range from <2 to 47 ppM. Anomalous concentrations of these variables are associated with the Farmington Canyon Complex. Variables which are associated with uranium include cerium, sodium, niobium, phosphorus, titanium, and yttrium.

4549 **(GJBX—238(80)(Pt.3)) Hydrogeochemical and stream sediment detailed geochemical survey for Thomas Range-Wasatch, Utah. Cottonwood project area.** Butz, T.R.; Bard, C.S.; Witt, D.A.; Helgerson, R.N.; Grimes, J.G.; Pritz, P.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Aug 1980. Contract AC13-76GJ01664. 363p. (K/UR—35(Pt.3)). NTIS, PC E12/MF$3.50.

Includes 1 sheet of 48 reduction microfiche.

Results of Cottonwood project area of the Thomas Range-Wasatch detailed geochemical survey are reported. Field and laboratory data are presented for 15 groundwater samples, 79 stream sediment samples, and 85 radiometric readings. Statistical and areal distributions of uranium and possible uranium-related variables are given. A generalized geologic map of the project area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Uranium concentrations in groundwater range from 0.25 to 3.89 ppB. The highest concentrations are from groundwaters from the Little Cottonwood and Ferguson Stocks. Variables that appear to be associated with uranium in groundwater include cobalt, iron, potassium, manganese, nickel, sulfate, and to a lesser extent, molybdenum and strontium. This association is attributed to the Monzonitic Little Cottonwood Stock, granodioritic to granitic and lampro-

phyric dikes, and known sulfide deposits. Soluble uranium concentrations (U-FL) in stream sediments range from 0.31 to 72.64 ppM. Total uranium concentrations (U-NT) range from 1.80 to 75.20 ppM. Thorium concentrations range from <2 to 48 ppM. Anomalous values for uranium and thorium are concentrated within the area of outcrop of the Little Cottonwood and Ferguson Stocks. Variables which are areally associated with high values of uranium, thorium, and the U-FL:U-NT ratio within the Little Cottonwood Stock are barium, copper, molybdenum, and zinc. High concentrations of these variables are located near sulfide deposits within the Little Cottonwood Stock.

4550 **(GJBX--241(80)) Hydrochemical and stream sediment detailed geochemical survey for Buffalo-Lignite, South Dakota.** Butz, T.R.; Bard, C.S.; White, R.E.; Helgerson, R.N.; Grimes, J.G.; Pritz, P.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Aug 1980. Contract AC13-76GJ01664. 824p. (K/UR—39). NTIS, PC E19/MF$3.50.

Includes 2 sheets of 48 reduction microfiche.

Statistical and areal distributions of uranium and possible uranium-related variables are displayed. Generalized geologic maps of the project areas are provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Groundwater in the Custer project area with anomalously high uranium concentrations occur along the eastern margins of North Cave Hill. Groundwater in this area is derived primarily from the Paleocene Tongue River Formation where high values were determined for U, 1000.U/specific conductance, 1000.U/B, U/SO_4, Ba, Ca, Mg, Mol, and Sr. Anomalously high uranium concentrations in stream sediments in the Custer project area are derived from the Paleocene Tongue River and Ludlow Formations and are found in four areas: (1) south of Table Mountain, (2) North Cave Hills, (3) east of South Cave Hills, and (4) surrounding Teppee Butte. Sediments with high uranium concentrations are associated with high values for U-FL/U-NT, As, Mo, and Se. Groundwater in the Slim Buttes project area with anomalously high uranium concentrations occur along the northern and southern regions of the Slim Buttes area. Groundwater in this area is derived almost exclusively from the Tertiary White River Group where high values were determined for U, 1000.U/specific conductance, 1000.U/B, U/SO_4, As, Se, and Si. Anomalously high uranium concentrations in stream sediments in the Slim Buttes project area are derived primarily from the Tertiary White River Group and the Arikaree-Ogallala Sediments. These high uranium concentrations are found primarily scattered along the Slim Buttes with slightly higher concentrations occurring in the central and southern regions. High concentrations are also found north of Flat Top Butte and in areas southeast of Slim Buttes. Sediments with high U concentrations are associated with high values for As, Co, Se, and V.

4551 **(GJBX—242(80)) Richfield 1° x 2° NTMS area, Utah: data report (abbreviated).** Bennett, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Sep 1980. Contract AC13-76GJ01664. 20p. (DPST—80-146-16). NTIS, PC E02/MF$3.50.

Includes 10 sheets of 24 reduction microfiche.

Results of groundwater and stream/surface sediment reconnaissance in the National Topographic Map Series (NTMS) Richfield 1° x 2° quadrangle are presented. Surface sediment samples were collected at 1546 sites, at a target sampling density of one site per 13 square kilometers. Groundwater samples were collected at 210 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in groundwater. Mass spectrometry results are given for helium in groundwater. Field measurements and observations are reported for each site. Data from groundwater sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements (water temperature, well description where applicable, and scintillometer reading), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, He, Mg, Mn, Na, and V). Data from sediment sites include (1) stream water chemistry measurements from sites where water was available, and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements, U/Th and U/Hf ratios, and scintillometer readings at sediment sample sites are included. Uranium concentrations in sediments of the Richfield quadrangle are relatively low, having a mean of 2.5 ppM and a maximum value of 68.3 ppM. The anomalously high values of uranium in Quadrangle CE correspond with the proportionately high values of thorium, suggesting that the uranium is present in resistate minerals. Groundwater and surface water sampling sites are too widely dispersed to allow preliminary interpretation.

4552 **(GJBX—243(80)) Trona 1° x 2° NTMS area, California: data report (abbreviated).** Bennett, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Sep 1980. Contract AC13-76GJ01664. 19p. (DPST—80-146-17). NTIS, PC E02/MF$3.50.

Includes 8 sheets of 24 reduction microfiche.

Results of groundwater and stream/surface sediment reconnaissance in the National Topographic Map Series (NTMS) Trona 1° x 2° quadrangle are presented. Two separate size fractions of surface sediments were collected at 898 sites, at a target sampling density of one site per 23 square kilometers. Groundwater samples were collected at 99 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in groundwater. Mass spectrometry results are given for helium in groundwater. Field measurements and observations are reported for each site. Data from groundwater sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements (water temperature, well description where applicable, and scintillometer reading), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, He, Mg, Mn, Na, and V). Data from sediment sites include (1) stream water chemistry measurements from sites where water was available, and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements; U/Th, U/Hf ratios; and scintillometer readings at sediment sample sites are included. Uranium concentrations in sediments of the Trona quadrangle are relatively low, with a mean of 1.3 ppM and a maximum value of 8.7 ppM in the coarse fraction, and a mean of 3.3 ppM and a maximum value of 29.5 ppM in the fine fraction. Groundwater and surface water sampling sites are too widely dispersed to allow preliminary interpretation.

4553 **(GJBX—245(80)) Aerial radiometric and magnetic survey national topographic map: Sonora, Texas. Final report.** (Geodata International, Inc., Dallas, TX (USA)). May 1980. Contract AC13-767GJ01664. 290p. NTIS, PC E11/MF $5.35.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Sonora National Topographic Map NH14-4 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

4554 **(GJBX—250(80)) Hydrogeochemical and stream sediment reconnaissance data display and listing for the Marfa NTMS Quadrangle, Texas.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Sep 1980. Contract AC13-76GJ01664. 161p. (K/UR—143). NTIS, PC E06/MF $3.50.

Includes 1 sheet of 48 reduction microfiche.

An abbreviated form of the HSSR Basic Data Report, consisting of field and laboratory data for 181 groundwater and 219 stream sediment samples, for the Marfa Quadrangle, Texas is presented. Detailed geochemical projects were previously reported for parts of the Marfa Quadrangle, therefore, reconnaissance samples

were collected in areas not included in the detailed geochemical projects.

4555 **(GJBX—253(80)) Geologic study of Kettle dome, northeast Washington. Final report.** (Cruson and Pansze, Geologists, Golden, CO (USA)). Oct 1980. Contract AC13-76GJ01664. 264p. NTIS, PC A12/MF A01.

This geologic study of Kettle dome, northeast Washington, encompasses an area of approximately 800 square miles (2048 sq km). The evaluation of uranium occurrences associated with the igneous and metamorphic rocks of the dome and the determination of the relationship between uranium mineralization and stratigraphic, structural, and metamorphic features of the dome are the principal objectives. Evaluation of the validity of a gneiss dome model is a specific objective. The principal sources of data are detailed geologic mapping, surface radiometric surveys, and chemical analyses of rock samples. Uranium mineralization is directly related to the presence of pegmatite dikes and sills in biotite gneiss and amphibolite. Other characteristics of the uranium occurrences include the associated migmatization and high-grade metamorphism of wallrock adjacent to the pegmatite and the abrupt decrease in uranium mineralization at the pegmatite-gneiss contact. Subtle chemical characteristics found in mineralized pegmatites include: (1) U increase as K_2O increases, (2) U decreases as Na_2O increases, and (3) U increases as CaO increases at CaO values above 3.8%. The concentration of uranium occurrences in biotite gneiss and amphibolite units results from the preferential intrusion of pegmitites into these well-foliated rocks. Structural zones of weakness along dome margins permit intrusive and migmatitic activity to affect higher structural levels of the dome complex. As a result, uranium mineralization is localized along dome margins. The uranium occurrences in the Kettle dome area are classified as pegmatitic. Sufficient geologic similarities exist between Kettle dome and the Rossing uranium deposit to propose the existence of economic uranium targets within Kettle dome.

4556 **(GJQ—003(80)) National Uranium Resource Evaluation, Scranton Quadrangle, Pennsylvania, New York, and New Jersey.** Baillieul, T.A.; Indelicato, G.J.; Penley, H.M. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Nov 1980. Contract AC13-76GJ01664. 38p. NTIS, PC E06/MF $3.50.

Includes 4 sheets of 24 reduction microfiche.

Reconnaissance and detailed geologic and radiometric investigations were conducted throughout the Scranton Quadrangle, Pennsylvania, New York, and New Jersey, to evaluate uranium favorability using National Uranium Resource Evaluation criteria. Surface and subsurface studies were augmented by aerial radiometric, hydrogeochemical and stream sediment reconnaissance, and emanometry surveys. Results of the investigations indicate four environments favorable for uranium deposits: In the Precambrian metamorphic terrain of the Reading Prong, magmatic-hydrothermal and anatectic deposits may occur in the northwestern massif; contact metasomatic deposits may occur in a portion of the southeastern massif. The alluvial-fan environment at the base of the Upper Devonian Catskill Formation appears favorable for deposits in peneconcordant channel controlled sandstones. Seven environments are considered unfavorable for uranium deposits: the southeastern massif of the Reading Prong, exclusive of that portion denoted as a favorable contact metasomatic environment; the lower Paleozoic sedimentary units; the Beemerville nepheline syenite complex; the Upper Devonian Catskill Formation, exclusive of the favorable basal alluvial-fan facies; Mississippian and Pennsylvanian units; and peat bogs. Two environments were not evaluated: the Spechty Kopf Formation, because of paucity of exposure and lack of sufficient data; and the Newark Basin, because of cultural density and inadequate subsurface information.

0504 Feed Processing

4557 **(DOE/EV/10299—T1) Evaluation of some equipment systems for retrieval, packaging, storing and transporting radioactive material from remedial action program sites.** (Dalton-Dalton-Newport, Cleveland, OH (USA)). Oct 1980. Contract AC05-79EV10299. 88p. NTIS, PC A05/MF A01.

This study examines equipment requirements for the Middlesex Sampling Plant, Middlesex, New Jersey; VITRO Rare Metals Plant, Canonsburgh, Pennsylvania; and VITRO Uranium Mill Tailings Pile, Salt Lake City, Utah, on the basis that these sites demonstrate the range of problems and situations to be met in the remedial action program. The study also includes an investigation of equipment systems currently in use at both Port Hope, Ontario, Canada, and Grand Junction, Colorado, to determine applicability to current DOE needs. Based upon data gathered from site visits, three equipment concepts were developed for retrieval, packaging, storing and transporting waste materials from remedial action projects. Equipment suppliers were contacted regarding cost, availability and performance specifications.

0505 Enrichment

REFER ALSO TO CITATION(S) 4599

4558 **(DOE/ET/33006—T1) Mission analysis for isotope separation/plasma separation process.** Cohen, S.L. (TRW Systems and Energy Group, Redondo Beach, CA (USA)). Jun 1978. Contract AC03-77ET33006. 46p. NTIS, PC A03/MF A01.

4559 **(UCRL—83516) Atomic vapor laser isotope separation at Lawrence Livermore National Laboratory: a status report.** Davis, J.I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 18p. (CONF-800208—25). NTIS, PC A02/MF A01.

From Topical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

The field of laser induced chemistry began in earnest early in the 1970's with the initiation of major efforts in laser isotope separation (LIS) of uranium. Though many specialized, small-scale photochemical and diagnostic applications have been identified and evaluated experimentally, and continue to show promise, currently the only high payoff, large-scale applications remain LIS of special elements. Aspects of the physical scaling, technology status and economic basis of uranium LIS are examined with special emphasis on the effort at LLNL.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 4596, 4600

4560 **(CONF-8005121—(Summ.)) Workshop on instrumentation and analyses for a nuclear fuel reprocessing hot pilot plant.** Babcock, S.M.; Feldman, M.J.; Wymer, R.G.; Hoffman, D. (Oak Ridge National Lab., TN (USA)). May 1980. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01.

From Workshop on instrumentation and analyses for a nuclear fuel reprocessing hot pilot plant; Oak Ridge, TN, USA (5 May 1980).

In order to assist in the study of instrumentation and analytical needs for reprocessing plants, a workshop addressing these needs was held at Oak Ridge National Laboratory from May 5 to 7, 1980. The purpose of the workshop was to incorporate the knowledge of chemistry and of advanced measurement techniques held by the nuclear and radiochemical community into ideas for improved and new plant designs for both process control and inventory and safeguards measurements. The workshop was athended by experts in nuclear and radiochemistry, in fuel recycle plant design, and in instrumentation and analysis. ORNL was a particularly appropriate place to hold the workshop since the Consolidated Fuel Reprocessing Program (CFRP) is centered there. Requirements for safeguarding the special nuclear materials involved in reprocessing, and for their timely measurement within the process, within the reprocessing facility, and at the facility boundaries are being studied. Because these requirements are becoming more numerous and stringent, attention is also being paid to the analytical requirements for these special nuclear materials and to methods for measuring the physical parameters of the systems containing them. In order to provide a focus for the consideration of the workshop participants, the Hot Experimental Facility (HEF) being designed conceptually by the CFRP was used as a basis for consideration and discussions.

4561 **(RFP—2864) Literature on fabrication of tungsten for application in pyrochemical processing of spent nuclear fuels.** Edstrom, C.M.; Phillips, A.G.; Johnson, L.D.; Corle, R.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 11 Oct 1980. Contract AC04-76DP03533. 51p. NTIS, PC A04/MF A01.

The pyrochemical processing of nuclear fuels requires crucibles, stirrers, and transfer tubing that will withstand the temperature and the chemical attack from molten salts and metals used in the process. This report summarizes the literature that pertains to fabrication (joining, chemical vapor deposition, plasma spraying, forming, and spinning) is the main theme. This report also summarizes a sampling of literature on molbdenum and the work previously performed at Argonne National Laboratory on other container materials used for pyrochemical processing of spent nuclear fuels.

0509 Transport And Storage

4562 **(CONF-801115—22) Special from encapsulation for radioactive material shipments from Oak Ridge National Laboratory.** Schaich, R.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 2p. NTIS, PC A02/MF A01.

From 6. international symposium on packaging and transporting radioactive material; Berlin, F.R. Germany (10 Nov 1980).

Special Form encapsulation has been used at Oak Ridge National Laboratory to ship radioactive solids for the past fifteen years. A family of inexpensive stainless steel containers has been developed and tested to meet the USA Department of Transportation (DOT) and the International Atomic Energy Agency (IAEA) regulations concerning radioactive material shipments as Special Form.

4563 **(HEDL—6835) Office of Nuclear Waste Isolation. Quarterly report, April-June 1980.** (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 13p. NTIS, PC A02/MF A01.

Progress is reported on spent fuel characterization equipment, spent fuel characterization, and spent fuel/package performance. Fuel assembly D04 was determined to have a decay heat value of 1580 watts. Destructive and nondestructive tests are underway on spent fuel rods. Model analysis showed fuel assembly fundamental frequency responses in the 1 to 2 Hz range under pinned end conditions. Nondestructive and destructive post-test examinations were conducted on rods removed from tests 2 and 2b. Differences between calculated and measured decay heats of spent fuel assemblies are discussed. Spent fuel/filler material interaction studies are underway. (DLC)

4564 **(UCRL—85078) Spent fuel test project, Climax granitic stock, Nevada Test Site.** Ramspott, L.D. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 24 Oct 1980. Contract W-7405-ENG-48. 4p. (CONF-8006102—3). NTIS, PC A02/MF A01.

From Rockstore 80 conference; Stockholm, Sweden (23 Jun 1980).

The Spent Fuel Test-Climax (SFT-C) is a test of dry geologic storage of spent nuclear reactor fuel. The SFT-C is located at a depth of 420 m in the Climax granitic stock at the Nevada Test Site. Eleven canisters of spent commercial PWR fuel assemblies are to be stored for 3 to 5 years. Additional heat is supplied by electrical heaters, and more than 800 channels of technical information are being recorded. The measurements include rock temperature, rock displacement and stress, joint motion, and monitoring of the ventilation air volume, temperature, and dewpoint.

4565 **Transportation logistics modeling for the spent fuel handling and packaging program.** Burnett, R.A.; Rolland, C.W.; Bower, J.C. (Battelle, Pac Northwest Lab, Richland, Wash). *USProceedings of the Summer Computer Simulation Conference (U.S.);* 914-919(1979). (CONF-790726—).

From Summer computer simulation conference; Toronto, Ontario, Canada (Jul 1979).

In support of the Department of Energy's Spent Fuel Handling and Packaging Program, two logistics models have been developed at Pacific Northwest Laboratory (PNL). These models have been used to provide information on current and future transportation system requirements for spent nuclear fuel shipments, to assist in spent fuel facility siting and design, and to ensure efficient use or disposal of the fuel. The first model, a transportation logistics model (Variable Site Model), computes a time-phased schedule of shipments of spent fuel elements from light water nuclear reactors to away-from-reactor storage basins and/or spent fuel handling and packaging facilities located at various alternative sites within the United States. The second model is a Facility Simulation Model which permits the analysis of various parameters associated with the design and operation of a spent fuel handling and packaging facility at a given site. 9 refs.

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 4954

0520 Waste Management

REFER ALSO TO CITATION(S) 4516, 4557, 4595, 4596, 4597, 4957, 4958, 5111, 5206, 5295, 5297, 5300, 5491, 5492, 5493

4566 **(CONF-801107—40) Radioactive waste management centers: an approach.** Lotts, A.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 40p. NTIS, PC A03/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Radioactive waste management centers would satisfy the need for a cost-effective, sound management system for nuclear wastes by the industry and would provide a well integrated solution which could be understood by the public. The future demands for nuclear waste processing and disposal by industry and institutions outside the United States Government are such that a number of such facilities are required between now and the year 2000. Waste management centers can be organized around two general needs in the commercial sector: (1) the need for management of low-level waste generated by nuclear power plants, the once-through nuclear fuel cycle production facilities, from hospitals, and other institutions; and (2) more comprehensive centers handling all categories of nuclear wastes that would be generated by a nuclear fuel recycle industry. The basic technology for radioactive waste management will be available by the time such facilities can be deployed. This paper discusses the technical, economic, and social aspects of organizing radioactive waste managment centers and presents a strategy for stimulating their development.

4567 **(CONF-801124—27) Sol-gel technology applied to crystalline ceramic nuclear waste forms.** Angelini, P.; Bond, W.D.; Caputo, A.J.; Mack, J.E.; Lackey, W.J.; Lee, D.A.; Stinton, D.P. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

The sol-gel process is being developed for the solidification and isolation of high-level nuclear fuel waste. Three gelation methods are being developed for producing alternative waste forms. These include internal gelation for producing spheres of up to 1 mm diam suitable for coating, external gelation, and water extraction methods for producing material suitable for alternate ceramic processing. In this study internal gelation has been used to produce ceramic spheres of various alternative nuclear waste compositions. A gelation system capable of producing 100-g batches has been assembled and used for development. Waste forms containing up to 70 wt % simulated Savannah River Plant waste have been produced. Dopants such as Cs, Sr, Nd, Ru, and Mo were used in some experiments to observe side waste streams and sintering effects. Synroc microspheres were coated with both low-density carbon, high-density impermeable carbon, high-temperature dense SiC, and SiC deposited at temperatures near 900°C. Other gelation methods and other alternative waste forms are being developed.

4568 **(CONF-801124—36) Loading and leakage of krypton immobilized in zeolites and glass.** Christensen, A.B.; Del Debbio, J.A.; Knecht, D.A.; Tanner, J.E. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1980. Contract AC07-79ID01675. 8p. NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

Krypton-85 is formed in nuclear power reactors and remains trapped until the fuel is reprocessed. Federal regulations limit the release of ^{85}Kr to the environment, requiring recovery and storage of 85% of the ^{85}Kr produced in commercial light-water reactors after January 1, 1983. One of the long-term storage options involves encapsulating ^{85}Kr in zeolites or glasses at high pressure and temperature. This paper presents experimental results for krypton encapsulation and leakage in sodalite, zeolite 5A, and Vycor Thristy glass. The results show that all three materials are feasible for ^{85}Kr immobilization and long-term storage, although zeolite 5A and Thirsty Vycor are preferable due to lower leakage rates.

4569 **(DOE/ID/05170—T1) Managing low-level radioactive wastes: a proposed approach.** (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1980. Contract AC07-76ID01570. 96p. NTIS, PC A05/MF A01.

This document is a consensus report of the Low-Level Waste Strategy Task Force. It covers system-wide issues; generation, treatment, and packaging; transportation; and disposal. Recommendations are made. (DLC)

4570 **(DOE/ID/12115—T1) ICPP injection well alternative project, Idaho National Engineering Laboratory. Final report.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA)). Oct 1980. Contract AC07-80ID12115. 607p. NTIS, PC A99/MF A01.

The Idaho Chemical Processing Plant (ICPP) portion of the Idaho National Engineering Laboratory (INEL) has been obtaining water needed for its operations from the Snake River aquifer, which occupies the entire region underlying the site. Most of this water has been used for cooling operating equipment, while a small portion has found various process uses. After passing through the ICPP process area, these waters are then returned to the aquifer. A small portion (about 1%) of the returned stream contains measurable amounts of radioactivity derived from the miscellaneous process users. This report and the recommendations contained herein are based upon stream flows projected for 1985 as supplied by DOE for the ICPP. 26 different alternatives for handling cooling water, chemical, and low level radioactive water disposal are examined. These cases are considered from technical, environmental, safety, and economic points of view. The level of detail is sufficient to eliminate non-viable cases, and to identify those which offer improvements over present practice. The Environmental/Safety Risk Factors were evaluated on a qualitative comparison basis only. Before a recommended improvement is incorporated into the waste disposal system, a conceptual design study should be made which would evaluate all those secondary effects and environmental factors that, by the very nature of the screening process, this study has not provided. Certain synergistic combinations have been noted and are discussed. This report does note whether the operations considered are in regulatory compliance, or are likely to be capable of providing lasting improvement to the waste water system. Qualitative comparisons were made between the various alternatives to confirm their relationship with applicable standards.

4571 **(DP-MS—80-47(Rev.)) Prediction of the lifetime of canisters for solidified radioactive wastes.** Rankin, W.N. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 12p. (CONF-801088—T(Rev.)). NTIS, PC A02/MF A01.

From National association of corrosion engineers; El Paso, TX, USA (28 Oct 1980).

The lifetime of canisters for solidified high-level radioactive waste was predicted by extrapolating the thickness of reaction zones on both the inside and outside of candidate canister alloys when these alloys were in contact with typical waste and repository materials. Candidate canister alloys in close contact with both glass and concrete waste forms and with salt from a potential repository site were heated for 20,000 h at temperatures expected during geologic storage of the waste forms. Results showed that 3/8-in.-thick Type 304L stainless steel canisters of waste glass stored in air or in dry salt would not be penetrated by reaction with the contents of the canister and oxidation of the outside of the canister for more than 8000 y. A low-carbon steel canister of waste glass would not be breached in more than 2000 y in dry salt storage. Oxidation would penetrate a similar low-carbon steel canister of waste glass stored in air in about 200 y. Type 304L stainless steel or low-carbon steel canisters of waste concrete stored in air or in dry salt would also be penetrated in about 200 y.

4572 **(DP-MS—80-96) Leach rate studies on glass containing actual radioactive waste.** Walker, D.D.; Wiley, J.R.; Dukes, M.D.; LeRoy, J.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 14p. (CONF-801206—3). NTIS, PC A02/MF A01.

From ORNL: conference on the leachability of radioactive solids; Gatinburg, TN, USA (9 Dec 1980).

Borosilicate glass containing radioactive wastes from the Savannah River Plant have been leached for 900 days. The International Standards Organization's (ISO) static leach test procedure was used on glass buttons in various leachants. Leach rates based on ^{90}Sr and ^{137}Cs analyses were similar: 2×10^{-8} to 3×10^{-8} g/(cm^2)(d) in distilled water, 1×10^{-8} to 3×10^{-7} g/(cm^2)(d) in pH 7 buffer, 3×10^{-7} to 7×10^{-7} g/(cm^2)(d) in pH 9 buffer, and 7×10^{-6} to 8×10^{-6} g/(cm^2)(d) in pH 4 buffer. Rates based on Pu analyses were the same as above in distilled water and pH 9 buffer, but were lower by an order of magnitude in pH 4 and pH 7 buffers. Almost all leach rates remained constant between 200 and 900 days of leaching. Increasing the concentration of the buffering agents had no effect on the leach rates at pH 7 (phosphate) and pH 9 (carbonate), but dramatically increased the rates at pH 4 (acetate). Leach rates did not differ significantly between high aluminum and high iron waste glasses.

4573 **(DP-MS—80-112) Computer modeling of groundwater flow at the Savannah River Plant.** Root, R.W. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 14p. (CONF-801145—3). NTIS, PC A02/MF A01.

From Geological Society of America meeting; Atlanta, GA, USA (17 Nov 1980).

A predictive model for the space-time distributions of hydraulic head and ground-water flow velocity has been developed for the vicinity of the low-level radioactive waste burial grounds at the Savannah River Plant. The hydraulic head distribution is being modeled using a computer code that solves the ground-water flow equation using a three-dimensional finite-difference scheme. Steady-state calibration of this model is complete, and transient calibration is under way.

4574 **(EGG—2055) TWTF project criticality task force final review and assessment.** McKinley, K.B.; Cannon, J.W.; Wheeler, F.J.; Worle, H.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1980. Contract AC07-76ID01570. 45p. NTIS, PC A03/MF A01.

The Transuranic Waste Treatment Facility (TWTF) is being developed to process transuranic waste, stored and buried at the Idaho National Engineering Laboratory, into a chemically inert, physically stable basalt-like residue acceptable at a federal repository. A task force was assembled by the TWTF Project Division to review and assess all aspects of criticality safety for the TWTF. This document presents the final review, assessments, and recommendations of this task force. The following conclusions were made: Additional criticality studies are needed for the entire envelope of feed compositions and temperature effects. Safe operating k/sub eff/'s need to be determined for process components. Criticality analyses validation experiments may also be required. SRP neutron interrogation should be replaced by DDT neutron interrogation. Accuracy studies need to be performed for the proposed assaying techniques. Time-correlated neutron monitoring needs to be mocked up for process components to prove feasibility and determine accuracy. The criticality control techniques developed for the TWTF conceptual design are in compliance with ERDAM 0530, including the Double Contingency Rule. Detailed procedures and controls need to be developed.

4575 **(ENICO—1042) Calcination of dilute zirconium waste.** Newby, B.J. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Nov 1980. Contract AC07-79ID01675. 128p. NTIS, PC A07/MF A01.

A method was developed for converting dilute zirconium wastes stored at the Idaho Chemical Processing Plant (ICPP) into granular, free-flowing solids using fluidized-bed calcination. Prior to calcination, the dilute zirconium wastes are blended with sodium-bearing waste so that the calcine produced contains as much as 5.3 mole % sodium; calcium nitrate is added to the blend to give a calcium-to-fluoride mole ratio of 0.7.

4576 (LA-UR—80-2864) Nonradiometric and radiometric testing of radioiodine sorbents using methyl iodide. Wood, G.O.; Valdez, F.O. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 17p. (CONF-801038—12). NTIS, PC A02/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

A nonradiometric test of adsorbents and adsorbers with normal methyl iodide ($CH_3{}^{127}I$) is desirable. Use of methyl radioiodide ($CH_3{}^{131}I$) requires special precautions and facilities and results in bed contamination. However, first it must be established to what extent the removal of $CH_3{}^{127}I$ by adsorbents is indicative of the removal of $CH_3{}^{131}I$. An experimental apparatus was built and used to simultaneously measure the penetrations of CH_3I molecules and the radioisotope in $CH_3{}^{131}I$ through charcoal absorbent beds. Gas chromatography with electron capture detection was used to measure CH_3I. Radioiodine was measured using charcoal traps within NaI scintillation well crystals. Real time (5-min interval) radioiodine measurement provided immediate penetration results directly comparable to the real time penetrations of methyl iodide. These penetrations were compared for typical charcoal adsorbents with these impregnants: (a) 5% KI_3, (b) 5% KI_3 + 2% TEDA, (c) 5% TEDA, and (d) metal salts (Whetlerite). Differences between CH_3I and $CH_3{}^{131}I$ penetrations observed for the two iodized charcoals were attributed to isotope exchange reactions. Equivalent penetrations were observed for non-iodized adsorbents and for iodized ones at initial time. First order rates were confirmed for reactions with TEDA and for isotope exchange. This was one more confirmation of the lack of a challenge concentration effect on efficiencies at low test bed loadings. In addition to other removal mechanisms, reversible physical adsorption was observed with all charcoals.

4577 (LA-UR—80-3432) Desorption of TEDA from impregnated charcoals. Wood, G. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-801038—19). NTIS, PC A02/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA. USA (20 Oct 1980).

Triethylenediamine (TEDA) is one of the most effective charcoal impregnants for trapping organic forms of radioiodine from air. It is used in air cleaning adsorbers, air samplers, and air purifying respirator canisters and cartridges for airborne radioiodine. Volatility of the pure crystals suggested the possibility of significant TEDA desorption in these applications, resulting in toxic levels of amine and/or degradation of sorbent efficiency. Measurements of TEDA desorption rates were made for four commercial charcoals. Temperatures of 70 to 120°C were used to give levels detectable with a photoionization detector. Extrapolations to temperatures nearer normal ambient were made by using Clapeyron equation plots. Among three charcoals with the same 5% level of TEDA impregnation, desorption rates varied over factors as great as 10. Slopes of Clapeyron plots were similar, giving an average 25 kcal/mol heat of desorption. This corresponds to a doubling of the TEDA desorption rate with each 5°C (9°F) rise in temperature. Desorption rates were directly proportional to airflow rates or velocities through the test beds and independent of humidity. Desorption rates per unit weight of charcoal decreased exponentially with bed depth, presumably due to TEDA readsorption. Calculations based on this data and the geometry of a standard adsorber cell showed that at normal ambient temperatures: (1) concentrations of TEDA in effluent air are well below expected toxic levels; and (2) losses of TEDA may be significant. At elevated temperatures TEDA desorption rates are high enough to affect methyl iodide trapping efficiencies and, possibly, charcoal ignition temperatures.

4578 (LBL—11651) Radioactive waste storage in mined caverns in crystalline rock: results of field investigations at Stripa, Sweden. Witherspoon, P.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 67p. (CONF-8010132—1). NTIS, PC A04/MF A01.

From 75th anniversary of the Illinois State Geological Survey symposium; Urbana, IL, USA (9 Oct 1980).

It is generally agreed that the most practicable method of isolating nuclear wastes from the biosphere is by deep burial in suitable geologic formations. Such burial achieves a high degree of physical isolation but raises questions concerning the rate at which some of these wastes may return to the biosphere through transport by groundwater. Any suitable repository site will be disturbed first by excavation and second by the thermal pulse caused by the radioactive decay of the wastes. To assess the effectiveness of geologic isolation it is necessary to develop the capability of predicting the response of a rock mass to such a thermal pulse. Ultimately, this requires field measurements below the surface in media representative of those likely to be encountered at an actual repository. Access to a granitic rock mass adjacent to a defunct iron ore mine at Stripa, Sweden, at a depth of about 350 m below surface has provided a unique opportunity to conduct a comprehensive suite of hydrological and thermo-mechanical experiments under such conditions. The results of these field tests have shown the importance of geologic structure and the functional dependence of the thermo-mechanical properties on temperature in developing a valid predictive model. The results have also demonstrated the vital importance of carrying out large-scale investigations in a field test facility.

4579 (MLM—2784) Tritium waste control: April-September 1980. Lamberger, P.H.; Rogers, M.L. (Mound Facility, Miamisburg, OH (USA)). 26 Nov 1980. Contract AC04-76DP00053. 30p. NTIS, PC A03/MF A01.

The Combined Electrolysis Catalytic Exchange (CECE) pilot system was operated using Maxey Flats trench water as feed. Two pneumatic seal electrolysis cells were procured. One will be used as a control (operated with nontritiated water) for the high-level tritiated water electrolysis tests. A test system for the cells was designed, built and successfully tested. Several additional impurity analyses were completed on effluent recovery system (ERS) water. Bench-scale experiments were conducted to define methods and parameters for removal of oil-organics from ERS water. Four types of activated carbon were used to absorb vacuum pump oil from 1 to 10% mixtures in water. Two experiments were conducted to determine the efficiency of the catalytic reactor to oxidize elemental tritium and also to determine the efficiency of the adsorption columns to capture the oxidized tritium. The resulting data indicate that reactor efficiency is >90% for concentrations on the order of 10 mCi/m^3, and about 50% at 0.5 mCi/m^3. The adsorption columns were also found to have less than the assumed 100% efficiency at capturing the HTO. Concentration data indicate possible channeling instead of breakthrough. The study of tritium release from representative burial packages continued. The two wastewater drums which have the highest tritium release (29 mCi and 85 mCi) also contain the highest amounts of tritium, originally 34,480 Ci and 52,128 Ci, respectively. The tritium release from the polymer-impregnated, tritiated concrete and the control remain too low to be illustrated on the current figures.

4580 (MLM—2786) Pelletized Waste Form Demonstration Program, April-September 1980. Lewis, E.L.; Herbert, R.F. Jr. (Mound Facility, Miamisburg, OH (USA)). 24 Nov 1980. Contract AC04-76DP00053. 14p. NTIS, PC A02/MF A01.

During this six-month reporting period, performance testing of waste/cement pellets was continued. These evaluations included radiolysis, leachability, and compressive strength. As a part of the Waste Certification Program, alpha radiolysis testing of strippable paint and polyurethane foam was also performed. No measurable amounts of gas were generated by alpha-radiolytic attack of the WD sludge/cement matrix. Gases were, however, generated in the paint and foam experiments. The installation and cold demonstration of the Production Waste Pelletization Line were accomplished. Several 1-in.-dia pellets with L/D ratios of 0.5 to 0.7 were manufactured using a semiautomatic press and die set. Hot pellets will be produced as scheduled during the month of October 1980.

4581 **(ONWI—115) Parametric study involving thermo/viscoelastic analyses of a room and pillar configuration.** Wagner, R.A. (RE/SPEC, Inc., Rapid City, SD (USA)). Jul 1980. Contract AC06-76RL01830. 96p. NTIS, PC A05/MF A01.

Thermo/viscoelastic analyses were performed to determine the sensitivity of three parameters important in the design of radioactive waste repositories. These three parameters were repository depth, ratio of pillar height to pillar width (extraction ratio), and thermal loading. The relative importance of each parameter was determined by comparison of both the thermal and mechanical results with the magnitude of room closure being the major comparative item. A single room-and-pillar configuration was investigated in this near field study using the finite element method. The constitutive law describing the viscous behavior of the host rock (bedded salt) was derived from laboratory testing of specimens from Lyons, Kansas. The most influential of the three parameters, based on the parameter ranges considered, was repository depth. The influence of ventilation greatly reduces the temperature distribution near the room periphery. An optimum ratio of pillar height to pillar width exists for every combination of thermal loading and repository depth.

4582 **(PNL—3372) Immobilization of high-level defense waste in a slurry-fed electric glass melter.** Brouns, R.A.; Mellinger, G.B.; Nelson, T.A.; Oma, K.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1980. Contract AC06-76RL01830. 109p. NTIS, PC A06/MF A01.

Scoping studies have been performed at the Pacific Northwest Laboratory related to the direct liquid-feeding of a generic high-level defense waste to a joule-heated ceramic melter. Tests beginning on the laboratory scale and progressing to full-scale operation are reported. Laboratory work identified the need for a reducing agent in the feed to help control the foaming tendencies of the waste glass. These tests also indicated that suspension agents were helpful in reducing the tendency of solids to settle out of the liquid feed. Testing was then moved to a larger pilot-scale melter (designed for ~ 2.5 kg/h) where verification of the flowsheet examined in the lab was accomplished. It was found that the reducing agent controlled foaming and did not result in the precipitation of metals. Pumping problems were encountered when slurries with higher than normal solids content were fed. A demonstration (designed for ~ 50 kg/h) in a full-scale melter was then made with the tested flowsheet; however, the amount of reducing agent had to be increased. In addition, it was found that feed control needed further development; however, steady-state operation was achieved giving encouraging results on process capacities. During steady-state operation, ruthenium losses to the offgas system averaged less than 0.16%, while cesium losses were somewhat higher, ranging from 0.91 to 24% and averaging 13%. Particulate decontamination factors from feed to offgas in the melter ranged from 5×10^2 to greater than 10^3 without any filtration or treatment. Approximately 1050 kg of glass was produced from 2900 L of waste at rates up to 40 kg/h.

4583 **(PNL—3564) Issues and scenarios for nuclear waste management systems analysis.** Mendel, J.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1980. Contract AC06-76RL01830. 18p. NTIS, PC A02/MF A01.

The Planning and Analysis Branch of the Department of Energy's Nuclear Waste Management Programs is developing a new systems integration program. The Pacific Northwest Laboratory was requested to perform a brief scoping analysis of what scenarios, questions, and issues should be addressed by the systems integration program. This document reports on that scoping analysis.

4584 **(PNL-SA—8358) Recovery and use of fission product noble metals.** Jensen, G.A.; Rohmann, C.A.; Perrigo, L.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 23p. (CONF-800607—91). NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Noble metals in fission products are of strategic value. Market prices for noble metals are rising more rapidly than recovery costs. A promising concept has been developed for recovery of noble metals from fission product waste. Although the assessment was made only for the three noble metal fission products (Rh, Pd, Ru), there are other fission products and actinides which have potential value. (DLC)

4585 **(PNL-SA—8521) Tributyl phosphate removal from reprocessing off-gas streams using a selected sorbent.** Parker, G.B. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 15p. (CONF-801038—18). NTIS, PC A02/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Laboratory experiments used small laboratory-scale columns packed with selected sorbent materials to remove tributyl phosphate (TBP) and iodine at conditions approaching those in actual reprocessing off-gas streams. The sorbent materials for TBP removal were placed upstream of iodine sorbent materials to protect the iodine sorbent from the deleterious effects of TBP. Methyl iodide in an airstream containing 30% TBP in normal paraffin hydrocarbons (NPH) and water vapor was metered to two packed columns of sorbents simultaneously (in parallel). One column contained a segment of 8-in. x 14-in. mesh alumina sorbent for TBP removal, the other did not. The measure of the effectiveness of TBP sorbent materials for TBP removal was determined by comparing the iodine retention of the iodine sorbent materials in the two parallel columns. Results from an 18 wt % Ag substituted mordenite iodine sorbent indicated that the iodine retention capacity of the sorbent was reduced 60% by the TBP and that the column containing iodine sorbent material protected by the alumina TBP sorbent retained 30 times more iodine than the column without TBP sorbent. TBP concentration was up to 500 mg/m^3. Similar experiments using a 7 wt % Ag impregnated silica gel indicated that the TBP vapor had little effect on the iodine retention of the silica gel material. The stoichiometric maximum amount of iodine was retained by the silica gel material. Further experiments were conducted assessing the effects of NO_2 on iodine retention of this 7 wt % Ag sorbent. After the two columns were loaded with iodine in the presence of TBP (in NPH), one column was subjected to 2 vol % NO_2 in air. From visual comparison of the two columns, it appeared that the NO_2 regenerated the silica gel iodine sorbent and that iodine was washed off the silica gel iodine sorbent leaving the sorbent in the original state.

4586 **(PNL-SA—8732) Radiation effects in crystalline high-level nuclear waste solids.** Weber, W.J.; Wald, J.W.; Gray, W.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1980. Contract AC06-76RL01830. 9p. (CONF-801124—33). NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

Glass, cement, and crystalline-ceramic waste forms are being considered as potential solid forms for incorporation of nuclear wastes. The solidified waste will be subjected to high doses of many different radiations which may measurably alter physical properties and/or affect the durability of the solid waste form. As a result, the long-term stability of these waste forms is a subject of continuing research. The present paper defines the general radiation damage problem and summarizes experimental results from studies of the effects of alpha decay, alpha bombardment, and transmutations on crystalline waste forms, related single-phase compounds and some glass waste forms. The results lead to the following conclusions: both alpha-recoil damage in actinide host phases and alpha damage to all other phases must be considered since significant structural changes may occur from either source; the ingrowth of damage follows exponential behavior for both alpha-recoil damage and alpha damage, leading to saturation effects in most materials; and preliminary results show no significant effect of transmutations on waste form stability.

4587 **(PNL-SA—8861) Improving long term resistance of uranium mill tailings covers to hydrologic stress using RIPRAP: a preliminary assessment.** Walters, W.H.; Skaggs, R.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 7p. (CONF-801155—1). NTIS, PC A02/MF A01.

From 3. annual symposium on uranium mill tailings management; Ft Collins, CO, USA (24 Nov 1980).

The long term effectiveness of riprap to protect uranium mill tailings repositories against erosion by flowing water is currently being evaluated by Pacific Northwest Laboratory for the US Nuclear Regulatory Commission. The investigation is part of a comprehensive study to determine technically justified and cost effective alternatives for armoring of radon suppression covers. As a protective cover, riprap appears to be one of the most reliable methods because of its proven durability to resist channel bed scour around bridge piers and erosion of river banks. Damage to radon suppression covers by water could occur under similar circumstances where the erosion would be due to overland flow or a large flood event. The principal mechanisms of soil erosion by water are discussed with respect to earth surfaces of mounted or flat geometries. Since long time periods on the order of one thousand years may be involved, any riprap design procedure should consider allowances for partial failures of the cover. Design procedures are summarized and both advantages and disadvantages are discussed. Problems that may occur over long term storage of mill tailings are evaluated in order to put the use of riprap in proper perspective.

4588 **(RHO-BWI-LD—24) Identification of candidate sites suitable for a geologic repository in basalt within Hanford.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Feb 1980. Contract AC06-77RL01030. 50p. NTIS, PC A03/MF A01.

The Basalt Waste Isolation Project (BWIP), under contract with the US Department of Energy, is charged with examining the feasibility of disposing of nuclear waste in a deep repository in basalt beneath the Hanford Site. One of the major tasks of the BWIP consists of identifying a site within Hanford which may be suitable for a nuclear waste repository. The site identification effort started in 1978 with geologic and hydrologic reconnaissance studies. The work will be completed with identification and characterization of the site considered suitable for a repository. The Detailed Site Characterization Report will provide a detailed description of site conditions and describe how the site satisfies the US Nuclear Regulatory Commission criteria for nuclear waste repositories. The site identification process to date has involved the following steps: development of guidelines and decision theory; assemblage and cataloging of existing data; screening of the data using a structured process; identification of site localities; and identification of an initial seven candidate sites. The first four steps are reported elsewhere. Step 5 is the subject of this report. Guidelines for screening were developed based on an analysis of existing and proposed regulations. The guidelines were designed to be sufficiently restrictive to provide a sorting mechanism. Seven contiguous candidate sites have been identified within the Hanford Site. Collectively, these sites encompass a 70-square-mile portion of the Cold Creek syncline. The candidate sites within the Cold Creek syncline satisfy the BWIP screening considerations. The critical criteria in the selection were the geologic and hydrologic considerations. Information gathered to date has not shown any major impediment to siting a geologic repository within the Cold Creek syncline.

4589 **(RHO-SA—189) Physical and chemical characterization of borosilicate glasses containing Hanford high-level wastes.** Kupfer, M.J.; Palmer, R.A. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Oct 1980. Contract AC06-77RL01030. 29p. (CONF-801124—35). NTIS, PC A03/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

Scouting studies are being performed to develop and evaluate silicate glass forms for immobilization of Hanford high-level wastes. Detailed knowledge of the physical and chemical properties of these glasses is required to assess their suitability for long-term storage or disposal. Some key properties to be considered in selecting a glass waste form include leach resistance, resistance to radiation, microstructure (includes devitrification behavior or crystallinity), homogeneity, viscosity, electrical resistivity, mechanical ruggedness, thermal expansion, thermal conductivity, density, softening point, annealing point, strain point, glass transformation temperature, and refractive index. Other properties that are important during processing of the glass include volatilization of glass and waste components, and corrosivity of the glass on melter components. Experimental procedures used to characterize silicate waste glass forms and typical properties of selected glass compositions containing simulated Hanford sludge and residual liquid wastes are presented. A discussion of the significance and use of each measured property is also presented.

4590 **(RHO-ST—32) Preliminary evaluation of alternative forms for immobilization of Hanford high-level defense wastes.** Schulz, W.W.; Beary, M.M.; Gallagher, S.A.; Higley, B.A.; Johnston, R.G.; Jungfleisch, F.M.; Kupfer, M.J.; Palmer, R.A.; Watrous, R.A.; Wolf, G.A. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Sep 1980. Contract AC06-77RL01030. 345p. NTIS, PC A15/MF A01.

A preliminary evaluation of solid waste forms for immobilization of Hanford high-level radioactive defense wastes is presented. Nineteen different waste forms were evaluated and compared to determine their applicability and suitability for immobilization of Hanford salt cake, sludge, and residual liquid. This assessment was structured to address waste forms/processes for several different leave-retrieve long-term Hanford waste management alternatives which give rise to four different generic fractions: (1) sludge plus long-lived radionuclide concentrate from salt cake and residual liquid; (2) blended wastes (salt cake plus sludge plus residual liquid); (3) residual liquid; and (4) radionuclide concentrate from residual liquid. Waste forms were evaluated and ranked on the basis of weighted ratings of seven waste form and seven process characteristics. Borosilicate Glass waste forms, as marbles or monoliths, rank among the first three choices for fixation of all Hanford high-level wastes (HLW). Supergrout Concrete (akin to Oak Ridge National Laboratory Hydrofracture Process concrete) and Bitumen, low-temperature waste forms, rate high for bulk disposal immobilization of high-sodium blended wastes and residual liquid. Certain multi-barrier (e.g., Coated Ceramic) and ceramic (SYNROC Ceramic, Tailored Ceramics, and Supercalcine Ceramic) waste forms, along with Borosilicate Glass, are rated as the most satisfactory forms in which to incorporate sludges and associated radionuclide concentrates. The Sol-Gel process appears superior to other processes for manufacture of a generic ceramic waste form for fixation of Hanford sludge. Appropriate recommendations for further research and development work on top ranking waste forms are made.

4591 **(SAND—80-0304) Subseabed radioactive waste disposal feasibility program: ocean engineering challenges for the 80's.** Talbert, D.M. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01.

The objective of the Subseabed Disposal Program is to assess the feasibility of disposing of high-level radioactive wastes or spent fuel in suitable geologic formations beneath the deep ocean floor. The program is entering a phase which will address engineering feasibility. While the current phase of the program to determine the scientific and environmental feasibility of the concept is not yet complete, activities to assess the engineering aspects are being initiated in parallel to facilitate the development of the concept on a time scale commensurate with related programs both in the United States and abroad. It is anticipated that engineering aspects will become the central focus of the program during the early 80's and will continue so through the establishment of a pilot-plant level activity which could occur by the mid-90's.

4592 **(SAND—80-2463C) Fluid migration studies in salt.** Shefelbine, H.C.; Raines, G.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 8p. (CONF-801209—3). NTIS, PC A02/MF A01.

From 2. annual National Waste Terminal Storage (NWTS) information meeting; Columbus, OH, USA (9 Dec 1980).

This discussion will be limited to the migration of water trapped in the rock salt under the influence of the heat field produced by nuclear waste. This is of concern because hypotheticl scenarios have been advanced in which this fluid movement allows radionuclides to escape to the biosphere. While portions of these scenarios are supported by observation, none of the complete scenarios has been demonstrated. The objectives of the present fluid migration studies are two-fold: 1. determine the character of the trapped fluid in terms of quantity, habitat and chemical constituents; and 2. define the mechanisms that cause the fluid to migrate toward heat

sources. Based on the observations to date, fluid migration will not have a major impact on repository integrity. However, the above objectives will be pursued until the impacts, if any, can be quantified.

4593 **(UCID—18796-80-2) Waste isolation program evaluation assistance. Second quarterly technical progress report.** Maninger, R.C.; Harvey, T.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Nov 1980. Contract W-7405-ENG-48. 53p. NTIS, PC A04/MF A01.

This report covers the effort for the second quarter on the Waste Isolation Program Evaluation Assistance Project at LLNL. During this period, previously prepared MDB charts were revised to incorporate comments received from the ONWI Planning Staff. Some improvements were also made in the graphical elements and syntax to improve the information content of the charts. The concept and use of adjacency matrices were also introduced to aid in the preparation of MBD description of plans.

4594 **Deep storage of nuclear waste: structural issues.** Day, D.A. (Stearns-Roger Eng Corp, Denver, Colo). *US-Journal of the Energy Division, ASCE (American Society of Civil Engineers) (U.S.)Formerly J.Power Div., Proc. Am. Soc. Civ. Eng.to former title, J. Soc. Chem. Ind., London;* **106**: No. 2, 201-212(Oct 1980).

The storage of radioactive waste materials has a long-term impact on the geology of a salt dome used for a repository deep in the ground. The heat densities of decaying radioactive waste affect the storage capacity and layout, as well as other factors for the repository. A typical salt dome is described along with the reasons favoring a central shaft pillar. Appropriate and reasonable extraction rates for design of the various supporting pillars are included. The heating load for a repository to store high level, intermediate level, and cladding hull canisters as well as drums of low level transuranic waste may be as high as 150 kW per acre initially. The storage arrangements and the near-field thermal evaluation are considered for their heating effect on the supporting masses of the salt dome. Design of the storage rooms accounting for creep of the surrounding surfaces is described. With the aforementioned structural issues analyzed, the final design and operations for the repository in a salt dome are described to give a perspective on their interaction. 6 refs.

0530 Environmental Aspects

4595 **(LA-UR—80-3366) Overview of resuspension model: application to low level waste management.** Healy, J.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 12p. (CONF-801217—1). NTIS, PC A02/MF A01.

From Symposium on modeling and low-level waste management; Denver, CO, USA (1 Dec 1980).

Resuspension is one of the potential pathways to man for radioactive or chemical contaminants that are in the biosphere. In waste management, spills or other surface contamination can serve as a source for resuspension during the operational phase. After the low-level waste disposal area is closed, radioactive materials can be brought to the surface by animals or insects or, in the long term, the surface can be removed by erosion. Any of these methous expose the material to resuspension in the atmosphere. Intrusion into the waste mass can produce resuspension of potential hazard to the intruder. Removal of items from the waste mass by scavengers or archeologists can result in potential resuspension exposure to others handling or working with the object. The ways in which resuspension can occur are wind resuspension, mechanical resuspension and local resuspension. While methods of predicting exposure are not accurate, they include the use of the resuspension factor, the resuspension rate and mass loading of the air.

4596 **(PNL—3473) Waste/Rock Interactions Technology Program. Status report on LWR spent-fuel leach tests.** Katayama, Y.B.; Bradley, D.J.; Harvey, C.O. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1980. Contract AC06-76RL01830. 51p. NTIS, PC A04/MF A01.

Spent fuels with burnups of 9000, 28,000 and 54,500 MWd/MTU have been leach tested at 25°C. Three leach-test procedures (Paige, IAEA and static) were used. IAEA and static tests were conducted in five different solutions: deionized water, sodium bicarbonate, sodium chloride, calcium chloride and Waste Isolation Pilot Plant B brine solutions. Elemental leach data are reported based on the release of $^{90}Sr+^{90}Y$, ^{106}Ru, ^{137}Cs, ^{144}Ce, ^{154}Eu, $^{239+240}Pu$, ^{125}Sb, ^{244}Cm, ^{129}I, ^{99}Tc, and total uranium. This is the first report on ^{129}I and ^{99}Tc from spent fuel. Termination of the Paige test showed that the plateout (radionuclide adsorption) on the test apparatus had negligible effect on the leach rate of cesium and plutonium, but a major (up to a factor of 50 times) effect on the curium leach rate. Three-hundred additional days of leach testing by the IAEA procedure, from 467 to 769 d, showed a continuation of the leaching trends observed during the first 467 d. Results from the first two static leach test series, 2 and 8 d, gave the ^{129}I and ^{99}Tc release numbers.

0540 Health And Safety

REFER ALSO TO CITATION(S) 4574

4597 **(DOE/AL/10752—5) Calculated radiation doses from deposition of material released in hypothetical transportation accidents involving WIPP-related radioactive wastes.** Channell, J.K. (New Mexico Health and Environment Dept., Santa Fe (USA)). Oct 1980. Contract AC04-78AL10752. 76p. NTIS, PC A05/MF A01.

A severe transportation accident resulting in the release of radioactive material during WIPP site operation is unlikely, but possible. Radioactive material deposited on the ground following an accident could deliver a radiation dose to people from the following pathways: (1) ingestion of contaminated food, milk or water; (2) inhalation of deposited material that is resuspended; (3) external radiation from material remaining near the surface. The total dose from these pathways may occur over a period of many years. This report presents the results of an analysis that estimates the maximum short-term (first year) and lifetime (70 years) doses that exposed individuals might receive. Also, the population doses that would result from contamination of irrigated food and animal feed crops are estimated. The expected reduction of these doses by protective actions was also considered.

4598 **Updated analysis of mortality of workers in a nuclear facility.** Gilbert, E.S.; Marks, S. (Pacific Northwest Lab., Richland, WA). Contract EY-76-C-06-1830. *USRadiation Research (U.S.);* **83**: No. 3, 740-741(Sep 1980).

An analysis of an updated file of deaths among Hanford workers is presented. No important changes in the results of the study are noted.

0550 Regulations

4599 **(DOE/ET/33006—T2) Nonproliferation and safeguards issues and the plasma separation process.** Rich, B. (TRW Systems and Energy Group, Redondo Beach, CA (USA)). 14 Jun 1978. Contract AC03-77ET33006. 31p. NTIS, PC A03/MF A01.

4600 **(LA—8384-MS) Review of selected dynamic material control functions for international safeguards.** Lowry, L.L. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 46p. NTIS, PC A03/MF A01.

With the development of Dynamic Special Nuclear Material Accounting and Control systems used in nuclear manufacturing and reprocessing plants, there arises the question as to how these systems affect the IAEA inspection capabilities. The systems in being and under development provide information and control for a variety of purposes important to the plant operator, the safeguards purpose being one of them. This report attempts to judge the usefulness of these dynamic systems to the IAEA and have defined 12 functions that provide essential information to it. If the information acquired by these dynamic systems is to be useful to the IAEA, the inspectors must be able to independently verify it. Some suggestions are made as to how this might be done. But, even if it should

not be possible to verify all the data, the availability to the IAEA of detailed, simultaneous, and plant-wide information would tend to inhibit a plant operator from attempting to generate a floating or fictitious inventory. Suggestions are made that might be helpful in the design of future software systems, an area which has proved to be fatally deficient in some systems and difficult in all.

4601 **(LA—8556-MS) Measurement of highly enriched uranium metal buttons with the high-level neutron coincidence counter operating in the active mode.** Foley, J.E. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 24p. (ISPO—120). NTIS, PC A02/MF A01.

The portable High-Level Neutron Coincidence Counter is used in the active mode with the addition of AmLi neutron sources to assay the ^{235}U content of highly enriched metal pieces or buttons. It is concluded that the portable instrument is a practical instrument for assaying uranium metal buttons with masses in the range 1.5 to 4 kg.

4602 **(LA-UR—80-3365) Potential nuclear safeguards applications for neutron generators.** Lindquist, L.O. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 3p. (CONF-801111—28). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

Many nuclear safeguards inspection instruments use neutron sources to interrogate the fissile material (commonly ^{235}U and ^{239}Pu) to be measured. The neutron sources currently used in these instruments are isotopics such as Californium-252, Americium-Lithium, etc. It is becoming increasingly more difficult to transport isotopic sources from one measurement location to another. This represents a significant problem for the International Atomic Energy Agency (IAEA) safeguards inspectors because they must take their safeguards instruments with them to each nuclear installation to make an independent measurement. Purpose of this paper is to review the possibility of replacing isotopic neutron sources now used in IAEA safeguards instruments with electric neutron sources such as deuterium-tritium (D-T, 14-MeV neutrons) or deuterium-deuterium (D-D, 2-MeV neutrons). The potential for neutron generators to interrogate spent-light water reactor fuel assemblies in storage pools is also reviewed.

06 FUSION FUELS

0603 By-products

REFER ALSO TO CITATION(S) 4612

4603 **(BNL—28600) Non-fossil energy for the production of synthetic fuels from coal. I. Fusion reactor with high temperature steam electrolyzer and gasifier.** Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract AC02-76CH00016. 14p. (CONF-801210—8). NTIS, PC A02/MF A01.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Fusion reactors could displace a large amount of the coal needed for synthetic fuel production. A unique feature of a fusion reactor is that it can potentially supply high temperature steam in the range of 1000° to 1500°C in a continuous manner. The high temperature steam would be obtained by internal heating of a refractory containing blanket section which would absorb the neutrons from the plasma. The water process stream would absorb the heat from the refractory, producing high temperature steam. The high temperature steam could be electrolyzed in a high temperature electrolyzer (HTE) and converted in a high temperature steam gasifier (HTSG) with coal. The HTE has the advantage of producing H_2 at 50 to 70% overall thermal efficiency. The HTSG has the advantages of eliminating the need for oxygen and excess coal to provide the endothermic heat of reaction for the water gas reaction. No switching valves or heat transfer surfaces are needed. Applying the fusion reactor in combination with HTE and HTSG for conversion of coal to synthetic natural gas (SNG) and liquid gasoline the efficiency of utilization of coal could be improved from 1.6 to 3.2 times for SNG and from 1.8 to 2.4 times for liquid fuel.

4604 **(BNL—28627) Review of fusion synfuels.** Fillo, J.A. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 13p. (CONF-801011—74). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

Thermonuclear fusion offers an inexhaustible source of energy for the production of hydrogen from water. Depending on design, electric generation efficiencies of ~ 40 to 60% and hydrogen production efficiencies by high-temperature electrolysis of ~ 50 to 65% are projected for fusion reactors using high-temperatures blankets. Fusion/coal symbiotic systems appear economically promising for the first generation of commercial fusion synfuels plants. Coal production requirements and the environmental effects of large-scale coal usage would be greatly reduced by a fusion/coal system. In the long term, there could be a gradual transition to an inexhaustible energy system based solely on fusion.

4605 **(BNL—28679) HYFIRE: a tokamak-high-temperature electrolysis system.** Fillo, J.A.; Powell, J.R.; Steinberg, M.; Benenati, R.; Horn, F.; Isaacs, H.; Lazareth, O.W.; Makowitz, H.; Usher, J. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 10p. (CONF-801210—9). NTIS, PC A02/MF A01.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Brookhaven National Laboratory (BNL) is carrying out a comprehensive conceptual design study called HYFIRE of a commercial fusion Tokamak reactor, high-temperature electrolysis system. The study is placing particular emphasis on the adaptability of the STARFIRE power reactor to a synfuel application. The HYFIRE blanket must perform three functions: (a) provide high-temperature (~ 1400°C) process steam at moderate pressures (in the range of 10 to 30 atm) to the high-temperature electrolysis (HTE) units; (b) provide high-temperature (~ 700° to 800°C) heat to a thermal power cycle for generation of electricity to the HTE units; and (c) breed enough tritium to sustain the D-T fuel cycle. In addition to thermal energy for the decomposition of steam into its constituents, H_2 and O_2, electrical input is required. Fourteen hundred degree steam coupled with 40% power efficiency results in a process efficiency (conversion of fusion energy to hydrogen chemical energy) of 50%.

4606 **(UCRL—84264) Parametric study of a target factory for laser fusion.** Sherohman, J.W.; Meier, W.R. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 8 Oct 1980. Contract W-7405-ENG-48. 36p. (CONF-801011—78). NTIS, PC A03/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

An analysis of a target factory leading to the derivation of production rate equations has provided the basis for a parametric study. Rate equations describing the production of laser fusion targets have been developed for the purpose of identifying key parameters, attractive production techniques and cost scaling relationships for a commercial target factory.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

4607 **(CONF-801157—1) Radioisotope powered light sources.** Case, F.N.; Remini, W.C. (Oak Ridge National Lab., TN (USA); Department of Energy, Washington, DC (USA). Div. of Advanced Nuclear Systems and Projects). 1980. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

From Annual aviation lighting seminar; Key West, FL, USA (17 Nov 1980).

Radioisotopes have been used for a number of years to excite phosphors to produce visible light. The advent of the nuclear age, however, made possible the preparation of radionuclides in larger quantities at relatively low prices, and with radiation properties that greatly expanded the potential applications for such lights.

Current energy conservation needs and inflation leading to even higher costs for maintenance and capital equipment has provided the incentive for development of illuminators for air field markers using both byproduct krypton-85 and processed tritium. Background and current status of these developments are discussed.

4608 **Electron energy recovery system for negative ion sources.** Dagenhart, W.K.; Stirling, W.L. (to Dept. of Energy). US Patent Application 088,223. 25 Oct 1979. 8p.

An electron energy recovery system for negative ion sources is provided. The system, employing crossed electric and magnetic fields, separates the electrons from the ions as they are extracted from the ion source plasma generator and before the ions are accelerated to their full energy. With the electric and magnetic fields oriented 90° to each other, the electrons remain at approximately the electrical potential at which they were generated. The electromagnetic forces cause the ions to be accelerated to the full accelerating supply voltage energy while being deflected through an angle of less than 90°. The electrons precess out of the accelerating field region into an electron recovery region where they are collected at a small fraction of the full accelerating supply energy. It is possible, by this method, to collect > 90% of the electrons extracted along with the negative ions from a negative ion source beam at < 4% of full energy.

0703 Isotopic Power Supplies

REFER ALSO TO CITATION(S) 5294

4609 **(TES—2865-23) Selenide isotope generator for the Galileo Mission. Monthly technical progress report.** (Teledyne Energy Systems, Timonium, MD (USA)). Oct 1978. Contract AC03-78ET33009. 130p. NTIS, PC A07/MF A01.

4610 **Thermocouple split follower.** Howell, L.J. (to Dept. of Energy). US Patent 4,204,882. 27 May 1980. Filed date 3 Dec 1965. 8p.

PAT-APPL-512,824.

Thermoelectric generator assembly is provided accommodating differential thermal expansion between thermoelectric elements by means of a cylindrical split follower forming a slot and having internal spring loaded wedges that permit the split follower to open and close across the slot.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 4603, 4605, 4661, 5125

4611 **(EUR—6764-FR) Improvement of the electrolytic process of hydrogen production. Final report.** (Commission of the European Communities, Luxembourg). 1980. 82p. (In French). NTIS (US Sales Only), PC A05/MF A01.

Testing of electrodes and membranes was performed both separately and in a complete electroysis apparatus. This complete electrolysis apparatus consists of a battery of six electrolyzers with 4 x 15 cm^2 electrodes and electrolyte flows and pressurization (4 atm). Main results are a total cell voltage around 1.8 to 1.9 V at 10 kA m^{-2}, 120°C 1 to 4 atm, under flow conditions and after aging (1200 h). High-temperature sintered electrodes show good erosion resistance, but diaphragms need external reinforcement not to be eroded. Temperature, pressure and electrolyte flow speed effects were thoroughly examined in order to determine optimal working conditions of the electrolyzers.

4612 **Hydrogen production using fusion energy and thermochemical cycles.** Dan, V.D.; Seinberg, M. (Brookhaven Natl Lab, Upton, NY). *GBInternational Journal of Hydrogen Energy (England);* **5**: No. 2, 119-129(1980).

Thermochemical cycles for the production of synthetic fuels would be especially suited for operation in conjunction with controlled thermonuclear fusion reactors because of very high temperature energy which such reactors could supply. Furthermore, fusion energy when developed is considered to be an inexhaustible supply of energy. Several high-temperature, two step thermochemical cycles for the production of hydrogen are examined. A thermodynamic analysis of the Fe/sub 3/O/sub 4/-FeO, CrCl/sub 3/-CrCl/sub 2/, and UCl/sub 4/-UCl/sub 3/ pairs reveals the feasibility of the processes. A more detailed process analysis is given for the Fe/sub 3/O/sub 4/-FeO system using steam as the heat transfer medium for decomposing the higher valent metal oxide for oxygen production, and hydrolyzing the lower oxide for hydrogen production. The steam could be heated to high temperatures by refractory materials absorbing the 14 MeV neutrons in the blanket region of a fusion reactor. 21 refs.

4613 **Hydrogen as the solar energy translator.** Kelley, J.H. (Calif Inst of Technol, JPL, Pasadena). *USProceedings, Intersociety Energy Conversion Engineering Conference (U.S.);* **1**: No. 79CH1477-9, 800-802(1979). (CONF-790803—).

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Solar-operated water-splitting process research shows promise for direct production of hydrogen from sunlight with efficiencies of up to 35 to 40 percent. The hydrogen can also serve as a storable energy form, easily and efficiently converted to electricity by fuel cells and other advanced-technology devices on a 24-hour basis or on demand with an overall efficiency of 25 to 30 percent. Thus, hydrogen serves as the fundamental translator of energy from its solar form to electrical form more effectively, and possibly more efficiently, than direct conversion. Hydrogen also can produce other chemical energy forms using solar energy. 5 refs.

0802 Storage

4614 **(BNL—28584) Kinetics of hydrogen absorption-desorption by metals.** Pick, M.A. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 16p. (CONF-8006130—2). NTIS, PC A02/MF A01.

From Advanced study institute on metal hydrides; Rhodes, Greece (17 Jun 1980).

This paper reviews some experimental studies and a theoretical model for the potential energies involved with the hydriding-dehydriding process. The paper first discusses the theoretical model in detail, then, in reviewing the experimental results, show how it applies to the model substances Nb and Ta and how two major predictions of the model are fulfilled. One of the predictions deals with the surface modifications which can enhance the hydrogen uptake rate and a second one with the temperature, coverage and pressure dependence of the sticking coefficient.

0803 Transport

REFER ALSO TO CITATION(S) 5044

0805 Safety

REFER ALSO TO CITATION(S) 4615

0806 Industrial And Commercial Use

REFER ALSO TO CITATION(S) 5044

4615 **Hydrogen fuel: problems and promises.** *USAutomotive Engineering (New York) (U.S.)Supersedes SAE (Soc. Automot. Eng.) J.;* **88**: No. 1, 42-45(Jan 1980).

The U.S. Dept. of Energy, Dept. of Transportation Energy Conservation, Los Alamos Scientific Laboratory, New Mexico Energy Institute, and the Deutsche Forschung und Versuchsanstalt fuer Luft und Raumfahrt (DFVLR) are participating in a cooperative effort to study problems involved in fueling automobiles with liquid hydrogen (LH/sub 2/) to demonstrate a vehicle of conventional appearance and performance operating on liquid hydrogen, and to demonstrate a liquid hydrogen refueling station operable by personnel with minimal training. A baseline vehicle will result, with which to compare and evaluate future improvements in vehicle per-

formance, liquid hydrogen storage systems, other hydrogen storage methods, and other synthetic fuels.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 4479, 4636, 5025, 5130, 5156

4616 (COO—2982-57) Conversion of cellulosic wastes to liquid fuels. Kuester, J.L. (Arizona State Univ., Tempe (USA). Coll. of Engineering and Applied Sciences). Sep 1980. Contract AS02-76CS40202. 74p. NTIS, PC A04/MF A01.

The current status and future plans for a project to convert waste cellulosic (biomass) materials to quality liquid hydrocarbon fuels is described. The basic approach is indirect liquefaction, i.e., thermal gasification followed by catalytic liquefaction. The indirect approach results in separation of the oxygen in the biomass feedstock, i.e., oxygenated compounds do not appear in the liquid hydrocarbon fuel product. The process is capable of accepting a wide variety of feedstocks. Potential products include medium quality gas, normal propanol, diesel fuel and/or high octane gasoline. A fluidized bed pyrolysis system is used for gasification. The pyrolyzer can be fluidized with recycle pyrolysis gas, steam or recycle liquefaction system off gas or some combination thereof. Tars are removed in a wet scrubber. Unseparated pyrolysis gases are utilized as feed to a modified Fischer-Tropsch reactor. The liquid condensate from the reactor consists of a normal propanol-water phase and a paraffinic hydrocarbon phase. The reactor can be operated to optimize for either product. The following tasks were specified in the statement of work for the contract period: (1) feedstock studies; (2) gasification system optimization; (3) waste stream characterization; and (4) liquid fuels synthesis. In addition, several equipment improvements were implemented.

4617 (LBL—11776) Stoichiometry of wood liquefaction. Davis, H.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01.

The overall chemistry of Douglas Fir liquefaction as evidenced by Rust Engineering Company's Test Run 8 at Albany, Oregon has been examined. It is concluded that the true total yield of non-gaseous product (oil + water solubles + char) is higher than was measured - probably as high as 52 to 55% of dry wood feed. Wood decomposes to give water and carbon dioxide, and carbon monoxide in the gas feed reacts with water to give carbon dioxide and hydrogen. However, there is a substantial net reaction of synthesis gas ($CO + H_2$) during the process. This indicates that the reaction CO + (wood product) = CO_2 + (reduced wood product) is important in formation of low oxygen product oil. Overall stoichiometry (approximate) is: 100 lbs wood + 0.5 Mol CO → 1.1 Mol CO_2 + 0.5 Mol H_2O + 55 lbs non-vapor product. Consumption of synthesis gas in the process is (very approximately) 1300 SCF/bbl product. The product oil has a hydrogen/carbon atom ratio of 1.2 and is highly aromatic. This analysis of the reaction applies specifically to the particular mode of operation used at Albany; i.e., to the so-called PERC process with a very high recycle of product oil. However, it is shown that the total yield of non-gaseous products is quite insensitive to the average analysis of the product. Thus we would expect total yields in the 50s with alternate processes - such as the LBL water slurry process. What will be different and must be determined is the distribution among water insoluble oil, water solubles and char and the degree of reduction of oxygen content by reaction with carbon monoxide.

4618 (LBL-PUB—350) Liquefaction of biomass. McCartney, J.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01.

The history of wood-to-oil conversion is presented. The conception of the liquefaction facility in Albany, Oregon and its start-up and operational difficulties are described. The chemistry of wood-to-oil conversion, including structural models of cellulose and lignin, is presented. The LBL Process is described in detail with diagrams. (DMC)

4619 (NE/BIO—80/12) Marine biomass: algae as source of energy. Edler, L.; von Wachenfeldt, T.; Emmelin, L. (Lund Univ. (Sweden)). Apr 1980. 100p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01.

The report deals with marine algae as a source of renewable energy. Interest has been focused on large (macroscopic) species of algae. They grow along all coasts and are naturally highly productive. Calculations based on data from laboratory and field measurements indicate that a production of as much as 115 tons of algae (dry matter) per hectare and year could be achieved. Culture of marine algae would along the Swedish coast probably take place in shallow, sheltered waters. Using a succession of naturally occuring species a growing season of 240 days could be achieved. With a production of 115 tons $dm.ha^{-1}.year^{-1}$ an output of ~ 110 $MWhT.ha^{-1}.year^{-1}$ of methane gas would be feasible using anaerobic fermentation. The area of the Baltic inside the 5-m depth curve is 19,000 sq km. If 10% of this area were available a production of around 20TWhT of gas annually would be the maximum potential of the system. The report describes a system for growing algae in the shallow marine environment. Energy analysis of the system indicates that ~ 5% of the energy output from an algae based methane plant would be required for growth, harvesting and conversion to methane.

4620 Process development for biomass liquefaction. Elliott, D.C. (Pacific Northwest Lab., Richland, WA). *USA-merican Chemical Society, Division of Fuel Chemistry, Preprints (U.S.);* **25**: No. 4, 257-263(1980). (CONF-800814—P3).

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

The biomass liquefaction processes (Bureau of Mines and LBL) in use at DOE's experimental facility in Albany, Oregon are described. The chemical composition of the distillate fractions is given. An economic analysis of the 2 processes showed that the LBL process requires less capital investment but the operational costs are very similar. When considered for use as a substitute fuel oil, wood oil as produced at Albany by the LBL process appears qualitatively to fall somewhere between petroleum derived # 6 Fuel Oil and the synthetic oil derived from the Occidental Flash Pyrolysis process. Wood oil falls nearly half way between the other two oils in nearly all categories except that wood oil is very low in sulfur content. This comparison is valid on a chemical basis, however, the use of wood oil purely as a substitute fuel is not currently economically attractive. Despite the large amount of resources already expended on research of this process, it remains in a developmental stage and new technology could have a significant impact on the process economics. The alternate use of wood oil as a chemical feedstock is also being studied.

0902 Alcohol Fuels

4621 (NP—25186) Ethanol production from acid hydrolyzed waste cellulose. Thomas, D.C. (Stone and Webster Engineering Corp., Boston, MA (USA)). Jun 1979. 64p. NTIS, PC A04/MF A01.

An analysis of a process proposed by A. Porteous to produce ethanol from urban wastes was conducted in order to assess its potential for use in the TVA region. This analysis was based on using waste newspapers and municipal solid wastes as feed to an acid hydrolysis and subsequent fermentation of the hydrolyzate to ethanol. It was concluded that this was not a cost effective process for the production of fuel grade alcohol. Several requirements of the process result in awkward designs and expensive equipment. Recommendations for development efforts to resolve process design questions are included.

4622 **Economic outlook for the production of ethanol from forage plant materials.** Moreira, A.R. (Colorado State Univ., Fort Collins); Linden, J.C.; Smith, D.H.; Villet, R.H. *USAmerican Chemical Society, Division of Fuel Chemistry, Preprints (U.S.);* **25**: No. 4, 285-296(1980). (CONF-800814—P3).

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

As an alternative to woody biomass, vegetative forage crops may be good substrates for ethanol fermentation due to their low lignin content. In this research project, vegetative alfalfa, vegetative sudan grass and vegetative, mature and ensiled sorghum species were tested as possible feedstocks for ethanol production. Results are presented here for the yield of sugars via cellulose hydrolysis of these materials and for the projected alcohol production costs for a 25 x 10^6 gallon/year plant. These costs ranged from $1.68/gallon for vegetative sudan grass to $2.58/gallon for vegetative alfalfa. Substrate costs comprised the major fraction of the total cost. This leads to the conclusion that a viable process economics depends on options such as the following: use of unconventional crops; stillage protein credit; co-hydrolysis of starch in immature grain component and sharing of feedstock production cost with mature grain harvest.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 4645, 5020, 5280

13 HYDRO ENERGY

1303 Plant Design And Operation

4623 **(SLAC-PUB—2613) Ultra headless hydro power.** Hall, F.F. (Stanford Linear Accelerator Center, CA (USA)). Sep 1980. Contract AC03-76SF00515. 4p. (CONF-801210—3). NTIS, PC A02/MF A01.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Ultralow head hydropower refers to power from large flows of fast currents of water such as fast-flowing rivers and swift-flowing ocean currents. Watermills for converting this kinetic energy to electric power are described briefly. (LCL)

1305 Economics And Management

4624 **Underground pumped hydro storage: an evaluation of the concept.** Fairfield, J.J.; Chang, G.C.; Jacobs, N.J. (Chas T. Main Inc, Boston, Mass). *USProceedings, Intersociety Energy Conversion Engineering Conference (U.S.);* No. 79CH1477-9, 399-404(1979). (CONF-790803—).

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

A review of the present state-of-the-art of Underground Hydroelectric Pumped Storage (UHPS) and an evaluation of the technical feasibility and economic viability of the concept are presented. Design criteria selected are 2000 MW capacity, 1200 m (4000 ft.) head, and 10 hour storage. UPHS offers substantial savings in investment costs compared to coal-fired cycling plants and in system production costs compared to gas turbine units.

14 SOLAR ENERGY

4625 **(SERI/TR—743-396(Vol.1)) Training for solar jobs: a follow-up of California CETA programs and their graduates.** Burns, B.A.; Mason, B.; Mikasa, G.Y. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1980. Contract AC02-77CH00178. 32p. NTIS, PC A03/MF A01.

This study assessed solar training offered by CETA-funded programs and labor market experiences of program graduates. The initial research was restricted to programs within California, because the state is involved in a variety of solar-related activities, including development of jobs and training programs in solar energy. Interviews were conducted with 12 CETA solar training programs and graduates in 1979, in cooperation with California's SolarCal Office. Information on graduates includes demographics, educational and work experience, satisfaction with solar training, types of jobs found, wage levels, and job tenure. Program information includes length, types of training, and the number and kinds of solar systems installed. Results show that major program problems were: limited funding; shortages of trained instructors; insufficient staff; need for local employment information; need for a better defined role for unions; and pressures for high placement rates. The curricula involved general skills, skills specific to solar technologies, and basic job behavior and skills. The training involved both classroom and hands-on experience and was mainly tailored to participants and the local job market. Successful placement of program participants was relatively high; over half the initial job placements involved solar energy. Solar jobs appeared to pay more than nonsolar jobs. Participants generally felt that their training had prepared them adequately for their current work.

1401 Resources And Availability

4626 **(SOLAR/0010—80/10) October 1980 environmental data for sites in the National Solar Data Network.** (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). Oct 1980. Contract AC01-79CS30027. 255p. NTIS, PC A12/MF A01.

Tables of available meteorological data for reporting sites in the National Solar Data Network are presented for the following: insolation, temperature, wind, and humidity. A technical discussion of the instruments and measurements used to obtain these data tables is included. A map illustrating the climate zones is provided. (MHR)

4627 **Model for determining the spectral quality of daylight on a horizontal surface at any geographical location.** Goldberg, B.; Klein, W.H. (Smithson Inst Radiat Biol Lab, Rockville, Md). *USSolar Energy. Journal of Solar Energy Science and Engineering (U.S.);* **24**: No. 4, 351-357(1980).

Using solar irradiance data gathered over 8 yrs, a simple model for determining daily and hourly totals of solar irradiance has been derived. The simplified model works well for broad spectral regions, i.e. the total irradiance, the visible (400 nm-700 nm), and the total IR (800 nm-2800 nm). The computational accuracy of the model of daily totals and hourly totals on clear days is within / plus or minus/10% when compared to values obtained from Eppley precision pyranometers. 6 refs.

1403 Economics

REFER ALSO TO CITATION(S) 4698

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 4678

4628 **(ANL/EES-TM—94) Magnetospheric effects of ion and atom injections by the satellite power system.** Chiu, Y.T.; Luhmann, J.G.; Schulz, M.; Cornwall, J.M. (Aerospace Corp., El Segundo, CA (USA); California Univ., Los Angeles (USA)). Jul 1980. Contract W-31-109-ENG-38. 119p. NTIS, PC A06/MF A01.

This is the final report of a two-year assessment of magnetospheric effects of the construction and operation of a satellite power system. This assessment effort is based on application of present scientific knowledge rather than on original scientific research. As such, it appears that mass and energy injections of the system are sufficient to modify the magnetosphere substantially, to the extent of possibly requiring mitigation measures for space systems but not to the extent of causing major redirection of efforts and concepts. The scale of the SPS is so unprecedentedly large, however, that these impressions require verification (or rejection) by in-depth assessment based on original scientific treatment of the principal issues. Indeed, it is perhaps appropriate to state that present ignorance far exceeds present knowledge in regard to SPS mag-

netospheric effects, even though we only seek to define the approximate limits of magnetospheric modifications here. Modifications of the space radiation environment, of the atmospheric airglow background, of the auroral response to solar activity and of the fluctuations in space plasma density are identified to be the principal impacts.

4629 **(SAND—80-7080) Potential effects of PURPA on photovoltaic systems for residential and light commercial use.** Eisenstadt, M.M. (Eisenstadt (Mel) and Associates, Inc., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01.

Both Title I and Title II of Public Utility Regulatory Policies Act (PURPA) can affect the economics of photovoltaic (PV) systems. Title I requires that the state Public Utility Commissions (PUCs) consider certain types of rate structures. These include declining block rates, time-of-day rates, seasonal rates and interruptible rates. The economic advantages that PV systems would acquire from such rates are discussed. Section 210 in Title II requires that utilities purchase power from and sell power to qualifying small power production facilities, and provides certain advantages to those facilities. The procedures by which a PV system becomes a qualifying small power production facility are covered in Section 201 of Title II. An analysis of those procedures is given, and it is shown that PV systems used for residential and light commercial buildings should not have problems with qualifying. Section 210 of Title II deals with the rates that a PV system owner will receive when he sells power to a utility and will pay when he purchases power. The general thrust of this section is that an economic incentive be provided to PV systems without requiring that the utilities subsidize them or that consumers pay higher rates than if the PV systems were not in existence. This is done by considering energy costs (cost of fuel) and capacity costs (primarily fixed costs) separately. Under some conditions, the PV system owner will receive only energy costs while under others he will receive both energy and capacity costs. Which conditions yield which rates are analyzed. The effect of energy storage systems on rates is analyzed since they provide some significant advantages. Finally, the effect of collector orientation is discussed. An economic benefit might result from orienting PV arrays somewhat west of due south.

4630 **Solar energy market penetration models: science or number mysticism?.** Warren, E.H. Jr. (Calif Inst of Technol, JPL, Pasadena). *USTechnological Forecasting and Social Change (U.S.)Supersedes Technol. Forecasting;* **16**: No. 2, 105-118(Feb 1980).

The paper reviews the assumptions underlying the structure of solar energy market penetration models and critiques their limitations. It is argued that the assumptions underlying the foundations of rigorously developed models, or the absence of a reasonable foundation for the remaining models, restrict their applicability. 20 refs.

1405 Solar Energy Conversion

4631 **(BMI—2054(Vol.1)) Research report on development of sweet sorghum as an energy crop. Volume I. Agricultural Task to US Department of Energy.** Arthur, M.F.; Davis, M.; Kresovich, S.; Lawhon, W.T.; Lipinsky, E.S.; Price, M.; Rudolph, A. (Battelle Columbus Labs., OH (USA)). 31 May 1980. Contract W-7405-ENG-92. 240p. NTIS, PC A11/MF A01.

An interregional experimental agricultural task was undertaken to evaluate biomass and sugar yields of sweet sorghum using similar cultural practices. Climatic conditions varied from North Dakota to southern Texas and Florida having respective frost-free days of 121 and 300. Maximum yields obtained in 1978 and 1979 at the various experimental locations ranged from 12.0 to 40.5 t/ha for dry biomass and from 2.9 to 13.2 t/ha for total sugars. Assuming 582 l of ethanol can be produced per metric ton of sugars, equivalent ethanol yields range from 1688 to 7682 l/ha. In addition to sweet sorghum, new sorghum hybrids, male-sterile corn, and sugarcane were investigated as potential sugar-stalk crops for producing ethanol from fermentation.

4632 **(BMI—2054(Vol.2)) Research report on development of sweet sorghum as an energy crop. Volume II. Commercialization studies to US Department of Energy.** McClure, T.A.; Scantland, D.A.; Woodford, P.G.; Gordon, W.A.; Kresovich, S.; Arthur, M.F.; Jackson, D.R.; Lipinsky, E.S. (Battelle Columbus Labs., OH (USA)). 31 Jul 1980. Contract W-7405-ENG-92. 207p. NTIS, PC A10/MF A01.

The following are discussed: economic and agronomic implications of commercial growers' sweet sorghum field tests, economics of sweet sorghum production, marketing and market organization concepts, and the effect of water availability upon potential increased production of sugar crops in Southern Florida and the Texas Rio Grande Valley. (MHR)

4633 **(DOE/CS/40213—T1) Technical and economic feasibility of membrane technology. Fourth technical progress report, June 17-September 16, 1980.** Sandre, A. (Beet Sugar Development Foundation, Fort Collins, CO (USA)). Oct 1980. Contract AC03-79CS40213. 46p. NTIS, PC A03/MF A01.

Progress is reported on the investigation of the potential application of reverse osmosis, ultrafiltration and electrodialysis to the system of solids concentration in beet sugar process streams. During this period, emphasis was put on running reverse osmosis tests with a new prototype machine to select the most suitable membranes for the concentrating of sugar solutions. An economic analysis of using reverse osmosis in a factory producing 10^6 gal/day of thin juice is discussed. (DMC)

4634 **(DOE/ET/20071—T3) Production of sugarcane and tropical grasses as a renewable energy source. First quarterly report, 1980-1981.** (Puerto Rico Univ., San Juan. Center for Energy and Environment Research). 1981. Contract AS05-78ET20071. 66p. NTIS, PC A04/MF A01.

Research continued on tropical grasses from Saccharum and related genera as sources of intensively-propagated fiber and fermentable solids. Final yield data for the second-ratoon crop of sugarcane and napier grass was compiled during the first quarter. The highest green matter yield for sugarcane was 92.0 tons/acre year (variety NCo 310). The highest dry matter yield, including trash, was 31.3 tons/acre year. For napier grass the highest green and dry matter yields were 88.9 and 22.4 tons/acre year, respectively. Sugar-cane quality was generally low but sugar yields were favorable when computed on a per acre basis. Sucrose content averaged 7.20% for all varieties and row spacings. Fiber content averaged 16.4%. The second ratoon crop averaged 6.18 tons sugar/acre (TSA) at standard row spacing and 5.71 TSA at narrow row spacing.

4635 **(DOE/ET/20279—95) Measuring PV module delamination.** Murphy, E.B. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 22 Sep 1980. Contract AS02-77CS34577. 13p. NTIS, PC A02/MF A01.

Delamination of the encapsulating pottant from both substrate and silicon cells in solar photovoltaic modules has been a common occurrence. While the extent of delamination is in some cases minor, there are other cases where appreciably large areas have been affected. At this time, most delaminated areas do not appear to cause electrical degradation of modules; however, keeping track of delamination growth and rate of growth is important and has been difficult. More accurate measurement of delamination has been achieved by using an acoustic digitizer to record the pattern of delamination. With the aid of a computer, software can be generated that shows the exact areas of delamination. By periodic measrement of those types of modules prone to delamination, growth rates can be documented.

4636 **(DOE/ET/20611—14) Research and evaluation of biomass resources/conversion/utilization systems (market/experimental analysis for development of a data base for a fuels from biomass model. Volume I. Biomass allocation model. Technical progress report for the period ending September 30, 1980.** Ahn, Y.K.; Chen, H.T.; Helm, R.W.; Nelson, E.T.; Shields K.J. (Gilbert Associates, Inc., Reading, PA (USA)). 1980. Contract AC02-78ET20611. 131p. NTIS, PC A07/MF A01.

A biomass allocation model has been developed to show the most profitable combination of biomass feedstocks thermochemical conversion processes, and fuel products to serve the seasonal conditions in a regional market. This optimization model provides a tool for quickly calculating the most profitable biomass missions from a large number of potential biomass missions. Other components of the system serve as a convenient storage and retrieval mechanism for biomass marketing and thermochemical conversion processing data. The system can be accessed through the use of a computer terminal, or it could be adapted to a portable micro-processor. A User's Manual for the system has been included in Appendix A of the report. The validity of any biomass allocation solution provided by the allocation model is dependent on the accuracy of the data base. The initial data base was constructed from values obtained from the literature, and, consequently, as more current thermochemical conversion processing and manufacturing costs and efficiencies become available, the data base should be revised. Biomass derived fuels included in the data base are the following: medium Btu gas low Btu gas, substitute natural gas, ammonia, methanol, electricity, gasoline, and fuel oil. The market sectors served by the fuels include: residential, electric utility, chemical (industrial), and transportation. Regional/seasonal costs and availabilities and heating values for 61 woody and non-woody biomass species are included. The study has included four regions in the United States which were selected because there was both an availability of biomass and a commercial demand for the derived fuels: Region I: NY, WV, PA; Region II: GA, AL, MS; Region III: IN, IL, IA; and Region IV: OR, WA.

4637 **(DOE/ET/23006—4) Investigation of solar cells based on Cu_2O. Final progress report May 1, 1979 to April 30, 1980.** Olsen, L.C. (Joint Center for Graduate Study, Richland, WA (USA)). 30 Jun 1980. Contract AC02-79ET23006. 61p. NTIS, PC A04/MF A01.

Investigations conducted over a 12-month period concerning Cu_2O as a material for low-cost solar cells are reported. Emphasis was placed on (1) Cu_2O substrate fabrication and characterization; (2) studies of Cu_2O cell photocurrent; (3) Cu_2O solar cell studies. Large grain polycrystalline Cu_2O substrates were fabricated by first oxidizing copper discs at 1050°C, and then polishing both sides to obtain 20 mil thick wafers. Optical constants were measured with ellipsometry and investigations of material microstructure were conducted. Photocurrent studies have included measurements of the internal photoresponse of Cu-Cu_2O Schottky barriers, and computer aided analyses to optimize the structure of such cells in order to achieve maximum photocurrent. As a result, a photocurrent of 8.52 mA/cm² has been demonstrated with a SiO(900 A)/Cu(90 A)/Cu_2O cell structure. Solar cell studies have concentrated on Cu-Cu_2O MIS structures. Improved Cu_2O surface preparation procedures were developed. Depth concentration profiles taken with Auger spectroscopy indicate that the copper-to-oxygen atomic ratio is essentially two, after one or two monolayers are removed. An AM1 efficiency of 1.76% was obtained with a Cu-Cu_2O cell. I-V analyses indicate that two current mechanisms are involved. A low voltage current component was identified as a thermally activated tunneling process, while a higher voltage mechanism is explained by a MIS model. The interfacial region is possibly a CuBr layer. The high voltage current component is characterized by $n \simeq 1.15$ and J/sub o/ $\simeq 2 \times 10^{-9}$ A/cm². Efforts are underway to eliminate the tunneling component and improve cell I-V characteristics by optimizing the MIS structure.

4638 **(DOE/ET/23007—3) $CdSiAs_2$ thin films for solar cell applications. Third quarter report, October 1, 1979-December 31, 1979.** Burton, L.C.; Slack, L.H. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Feb 1980. Contract AC02-79ET23007. 18p. NTIS, PC A02/MF A01.

Sputtering studies (single composite target; $CdAs_2$ + Si) of $CdSiAs_2$ films have continued. An improved substrate has been developed (Ta film on 7059 glass) for post-deposition heat treatments, although films still have mechanical defects. High resistivity (rho $> 10^6\ \Omega\ \mu m$) polycrystalline p-type films with optical cutoff at 1.53 eV and absorption coefficient of $\sim 2 \times 10^4\ cm^{-1}$ at 0.6 μm have been obtained. CdS/$CdSiAs_2$ and In/$CdSiAs_2$ junctions have been formed on heat treated $CdSiAs_2$ films. Both junction types exhibit rectifying behavior, although with little photovoltaic response. Poor yield and unstable characteristics are attributed to mechanical defects in the $CdSiAs_2$ films. The new multi-target sputtering unit is now installed and operating. It is planned to begin the transfer of the sputtering studies over to this unit during the next reporting period.

4639 **(DOE/JPL/954373—80/17) Silicon ingot casting: heat exchanger method (HEM). Multi-wire slicing: fixed abrasive slicing technique (FAST). Phase IV. Silicon sheet growth development for the large area sheet task of the low-cost solar array project. Quarterly progress report No. 3, July 1, 1980-September 30, 1980.** Schmid, F.; Khattak, C.P.; Basaran, M. (Crystal Systems, Inc., Salem, MA (USA)). Oct 1980. Contract NAS-7-100-954373. 32p. NTIS, PC A03/MF A01.

The size of ingots cast by HEM has been increased to 45 kg with 34 cm x 34 cm and 32 cm x 32 cm cross-sections. A new crucible has been developed which has a better shape factor. It has shown considerable improvement in yields of square ingots. A 45 kg ingot was solidified in this crucible. Optimization of the solidification cycle has shown that as the height of the ingot is increased, the gradients at the bottom, as well as instrumentation control, have to be very precise for efficient solidification. A new cutting head has been fabricated and assembled with the present drive unit of the FAST slicer. In addition to the salient features of rigidity and accurate alignment, the bladehead is lighter and larger to accommodate a 30 cm wide wirepack. Surface speeds of 500 ft/min were achieved with minimum vibration. Encouraging results have been achieved with the new cutting heat cutting head. High cutting rates and yields, 5.1 mils/min and 96%, respectively, have been seen from electroplated bladepacks. Electroplated wires with diamonds in cutting edge only have been used during the present reporting period with good slicing performance. The impregnated wirepacks have also demonstrated cutting effectiveness with the new bladehead.

4640 **(DOE/JPL/954559—78/7) Solar silicon via the Dow Corning process. Final report.** Hunt, L.P.; Dosaj, V.D. (Dow Corning Corp., Hemlock, MI (USA). Solid-State Research and Development Lab.). Oct 1979. Contract NAS-7-100-954559. 109p. NTIS, PC A06/MF A01.

The process developed meets the LSA Project objective of demonstrating technical feasibility for high-volume production of solar-cell-grade silicon. The process consists of producing silicon from pure raw materials via the carbothermic reduction of quartz. This silicon was then purified to solar grade by impurity segregation during Czochralski crystal growth. Commercially available raw materials were used to produce 100-kg quantities of silicon during 60-hour periods in a Direct Arc Reactor. This silicon had impurity concentrations of less than 10 ppmw each, except for Al and Fe (50 to 100 ppmw). Purification of this material by Czochralski crystal growth gave silicon of semiconductor purity, except for Al (1 ppma), B (7 ppma, 0.1 ohm-cm), and P (0.5 ppma). This silicon produced single crystalline ingot, during a second Czochralski pull, that was fabricated into solar cells having AM1 efficiencies ranging from 8.2% to greater than 14% (AR-coated). An energy analysis of the entire process indicated a 5-month payback time. A price of $12.15 (1980 dollars, with profit) was estimated for a 3000-metric-ton-per-year plant. Further process development is recommended based upon technical success, estimated product cost, and commercially-available technology already existing in the industry that can be applied to process scale-up.

4641 (DOE/JPL/954853—80/10) Investigation of proposed process sequence for the array automated assembly task. Phase I and II. Final report, October 1, 1977-June 30, 1980. Mardesich, N.; Garcia, A.; Eskenas, K. (Spectrolab, Inc., Sylmar, CA (USA)). Aug 1980. Contract NAS-7-100-954853. 480p. NTIS, PC A21/MF A01.

A selected process sequence for the low cost fabrication of photovoltaic modules was defined during this contract. Each part of the process sequence was looked at regarding its contribution to the overall dollars per watt cost. During the course of the research done, some of the initially included processes were dropped due to technological deficiencies. The printed dielectric diffusion mask, codiffusion of the n+ and p+ regions, wraparound front contacts and retention of the diffusion oxide for use as an AR coating were all the processes that were removed for this reason. Other process steps were retained to achieve the desired overall cost and efficiency. Square wafers, a polymeric spin-on PX-10 diffusion source, a p+ back surface field and silver front contacts are all processes that have been recommended for use in this program. The printed silver solderable pad for making contact to the aluminum back was replaced by an ultrasonically applied tin-zinc pad. Also, the texturized front surface was dropped as inappropriate for the sheet silicon likely to be available in 1986. Progress has also been made on the process sequence for module fabrication. A shift from bonding with a conformal coating to laminating with ethylene vinyl acetate and a glass superstrate is recommended for further module fabrication. The finalized process sequence is described.

4642 (DOE/JPL/955533—793) Development of a polysilicon process based on chemical vapor deposition: Phase 1. Third quarterly progress report, 1 April-30 June 1980. Sharp, K.; Arvidson, A.; Plahutnik, F.; Sawyer, D. (Hemlock Semiconductor Corp., MI (USA)). Aug 1980. Contract NAS-7-100-955533. 54p. NTIS, PC A04/MF A01.

The goal of this program is to demonstrate that a dichlorosilane-based reductive chemical vapor deposition (CVD) process is capable of production, at low cost, high quality polycrystalline silicon. Physical form and purity of this material will be consistent with LSA material requirements for use in the manufacture of high efficiency solar cells. The feasibility of silicon generation from dichlorosilane has been well established in the program to date. A number of runs have been conducted over a broad range of conditions in an experimental CVD reactor. Optimization of silicon production reactor behavior has been approached via an experimental design program in which system responses are correlated with reactor operating parameters. The program has been conducted in the experimental reactor by systematically varying the conditions of feed and rod temperature for the various runs. In support of the Process Development Unit (PDU), a laboratory rearranger unit has been utilized to provide information relating to kinetics of trichlorosilane redistribution, catalyst behavior, and to allow development of reliable analytical techniques. Kinetic parameters have been determined for liquid phase redistribution at 77°C and are more favorable than originally anticipated. Activities related to the EPSDU have progressed to include an energy balance for the plant, and a material balance revised on the basis of new analytical data from gas chromographic sampling of reactor vent gases. (WHK)

4643 (Ds-I—1980-4) Basis for using forest energy in Sweden. A report from the working group for forest energy of the Swedish Commission for Oil Substitution. (LiberFoerlag Allmaenna Foerlaget, Stockholm (Sweden)). 18 Feb 1980. 76p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01.

The possibilities of an increased use of logging wastes, low-grade wood and straw for energy production are discussed. To facilitate such a transition it is suggested that the state authorities help in establishing trade channels for these fuels, that Rand D is intensified and that the necessary investments are supported through favorable financing. It is estimated that by 1990 Sweden could supply 3 to 3.5 Mtoe through these energy sources.

4644 (IS—4745) Photochemical solar cells based on d-band electrochemistry at transition metal diselenides. Technical progress report, second quarter, year one. Parkinson, B.A.; Furtak, T.E. (Ames Lab., IA (USA)). May 1980. Contract AC02-77CH00178;W-7405-ENG-82. 34p. NTIS, PC A03/MF A01.

Single crystals of the layered semiconductor tungsten diselenide have been grown by chemical vapor transport and evaluated as the photoanode in a n-WSe_2/1M KI-0.1mI_2/Pt photoelectrochemical cell. Progress is detailed. In situ topographic photogenerated carrier collection analysis with a scanning laser spot technique has verified that crystal edges exposed to the electrolyte are a major source of efficiency losses in the light to electrical energy conversion. Surface states due to edge sites have been detected with subband gap photocurrent spectroscopy and found to be located 0.2 eV below the conduction band edge. Several approaches have been demonstrated for the specific chemical treatment of the edge sites to reduce the effect of the surface states and increase the energy conversion efficiency. It was also found that iodine reduction (dark current) via these surface states is another factor in limiting cell efficiency.

4645 (IVA—171) Maximum use of raw material in forestry, Sweden. Kilander, K. (Ingenjoersvetenskapsakademien, Stockholm (Sweden)). Jan 1980. 61p. (In Swedish). NTIS, PC A04/MF A01.

A survey is given of different investigations of the possibilities to use forest wastes for energy production in Sweden. Several organizations and firms work with systems for felling, transportation, production of chips and pelletization. The forest products can be used for combustion in one-family houses, district heating plants and in industry.

4646 (LA-UR—80-3387) Constraints to bio-energy development. Parsons, V.B. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-801210—7). NTIS, PC A02/MF A01.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

The energy crisis has prompted research and development of renewable, domestic, cost-effective and publicly acceptable energy alternatives. Among these are the bioconversion technologies. To date bio-energy research has been directed toward the mechanics of the conversion processes and technical assessment of the environmental impacts. However, there are other obstacles to overcome before biomass can be converted to more useful forms of energy that fit existing need. Barriers to bio-energy resource application in the US are identified. In addition, examples from several agricultural regions serve to illustrate site-specific resource problems.

4647 (NP—25184) Directory of Tennessee's forest industries 1980. (Tennessee Valley Authority, Norris (USA). Div. of Land and Forest Resources). Sep 1980. 153p. NTIS, PC A08/MF A01.

A directory of primary and secondary forest industries is presented. Firm names and addresses are listed by county in alphabetical order. The following information is listed for each industry: type of plant, production and employee size class, products manufactured, and equipment. For the primary industries, the major species of trees used are listed. (MHR)

4648 (NP—25191) Provisional forest biomass statistics for the 201-county Tennessee Valley Region. (Tennessee Valley Authority, Norris (USA)). Mar 1980. 50p. NTIS (US Sales Only), PC A03/MF A01.

Aboveground green weights of biomass (i.e., wood, bark, and foliage) by forest component (i.e., merchantable trees, cull trees, understory, logging residue, and surplus growth) are presented for each county within the 201-county Tennessee Valley Region. Both total and per-acre weights are shown. Total biomass is estimated at nearly 3 billion green tons and averages 95.08 tons per acre of commercial forest. Maximum annual availability of forest biomass (AAB) is estimated to be 51 million green tons, or 1.7% of total biomass. Annual available biomass is defined as the upper limit of total aboveground gross green weight of wood, bark, and foliage that could theoretically be harvested annually for both

energy and traditional products in the absence of any physical, socioeconomic, or environmental constraints, other than a 2.0% (annual compound rate) reserved growth for inventory buildup. Data sources, reliability, assumptions, conversion factors, and formulas are discussed.

4649 **(PB—80-176340) Industrial hygiene characterization of the photovoltaic solar cell industry. Technical report.** Briggs, T.M.; Owens, T.W. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Mar 1980. Contract PHS-NIOSH-210-78-0059. 345p. NTIS, PC A15/MF A01.

The information presented in this report is based on a comprehensive literature review and walk-through surveys of 14 production or research and development facilities. The investigation covers the technology from base material preparation through final module assembly. Descriptions are given of major technologies under development and the associated chemical and physical agents to which workers could be exposed. Indepth sampling surveys were conducted. Industrial hygiene concerns connected with each major technology are presented. Available health effects literature is listed for the chemicals used in all reviewed technologies.

4650 **(SAN—1616-1) Maine Firewood Study. Final report, 19 September 1977-30 September 1978.** Swain, E.W. (Maine Audubon Society, Portland (USA)). Jul 1979. Contract FG03-77AD01616. 161p. NTIS, PC A08/MF A01.

The Maine Firewood Study was initiated to assess the demand for wood energy and to determine the effectiveness of market mechanisms in meeting that demand. In addition, the concern for the implications of increased firewood harvesting from small woodlots caused Maine Audubon to sponsor a corps of firewood specialists to assist small woodlot owners. To gauge statewide firewood use a comprehensive telephone survey was conducted during the winter of 1977-1978. The survey revealed high levels of firewood use in one-half of the homes in Maine. A personal interview survey of firewood producers was also initiated to determine their harvesting and marketing practices. The conclusions of this effort supported an original premise of the study: existing small scale, disparate marketing mechanisms could not provide consumers with a reliable, consistently priced source of firewood. A marketing mechanism analysis was therefore undertaken to assess the demand for marketability of woodfuel. Results of this analysis included projections of impediments and incentives to large-scale marketing ventures. The goal of the Maine Firewood Study was to collect and disseminate information to facilitate widespread, intelligent use of wood energy resource.

4651 **(SAND—80-1494) Comparative analysis of combined flat-plate PV/T collectors with separate PV/T collectors.** Hoover, E.R. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01.

The purpose of this study is to determine the conditions under which a combined photovoltaic/thermal (PV/T) collector is more cost effective than separate flat-plate photovoltaic and thermal collectors. The annual performance of the separate PV/T system and four different combined PV/T systems are simulated in two geographical locations using a system analysis computer program. Based on equivalent electrical and thermal outputs and the 1986 DOE cost goal for PV modules (70 cents/Wp), the maximum allowable incremental cost to upgrade the conventional thermal collector to a combined PV/T collector is determined. For all of the cases considered in this study, the separate PV/T collectors are more cost effective than the combined PV/T collectors.

4652 **(SAND—80-1612) Photovoltaic Advanced Systems Test Facility description and operations plan.** Gerwin, H.J. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01.

The Photovoltaic Advanced Systems Test Facility (PASTF) is operated by Sandia National Laboratories for the Department of Energy. Photovoltaic modules and arrays are tested in the PASTF, along with power conditioning units and energy storage equipment related to photovoltaic systems. The test facility description, collector test plan, and user interface information are presented.

4653 **(SAND—80-7068) High concentration silicon photovoltaic cell development.** Allendorf, G.; Frank, R.; Goodrich, J.; Matthei, W. (Microwave Associates, Inc., Burlington, MA (USA)). Jun 1980. Contract AC04-76DP00789. 115p. NTIS, PC A06/MF A01.

The objective of this study is to develope practical semiconductor photocells: 1) for use is high concentration system (at leat 25 suns at air-mass-one), 2) having 18% or more efficiency, 3) using state-of-the-art silicon material and device technology, and 4) amenable to low cost photovoltaic production of electrical energy from solar radiation. Work accomplished at Microwave Associates (M/A) from the initiation of the contract on November 27, 1978 to February 29, 1980, is described. (WHK)

4654 **(SAND—80-7072) Further development of a novel solar cell concentrator photovoltaic converter system: final report.** Vander Plas, H.A.; Gregory, P.E. (Varian Associates, Inc., Palo Alto, CA (USA)). Oct 1980. Contract AC04-76DP000789. 49p. NTIS, PC A03/MF A01.

Previously a photovoltaic converter using an optical filter to split the solar spectrum and focus the light onto two cells was built and tested. Conversion efficiencies for the test module ranged from 27.0% at 113 suns to 26.0% at 489 suns. The construction of this module was guided by a theoretical analysis of the efficiencies to be expected from a variety of bandgap combinations. The purpose of this program is to continue the investigation of all elements of the spectral splitting approach. A major emphasis of the program is the extension of the spectral splitting principle to a three-gap conveter. This includes the extension of the theoretical analysis to include the properties of the optical filter. The theoretical analysis is given, and the feedback provided by this analysis to the rest of the program is emphasized. Research on germanium, silicon, and AlGaAs/Al/sub x/Ga/sub 1-x/As solar cells is described. (WHK)

4655 **Proceedings of the alcohol fuel production and utilization conference.** Lincoln, NE; Nebraska Center for Continuing Education (1980). 113p. (CONF-8003109—).

From Alcohol fuel production and utilization conference; Lincoln, NB, USA (13 Mar 1980).

A conference was held to provide farmers, businesses, industries, and specialty groups with the best available information on current and projected activities related to the production and utilization of biomass for alcohol fuels. All aspects of the alcohol fuel production and utilization process were discussed. From biomass sources, through conversion processes to end-use products and applications were topics discussed by numerous experts. Other experts took this basic information and put it together into total systems. Speakers presented overviews on alcohol fuel related activities on state, regional, and national levels. Finally, commercialization incentives, funding sources, environmental considerations, research developments, safety considerations, and regulatory requirements were discussed as factors which must be addressed when considering the production and utilization of alcohol fuels. Separate abstracts have been prepared for items within the scope of the Energy Data Base.

4656 **(SERI/PR—8143-1-T1) Development of copper sulfide/cadmium sulfide thin film solar cells.** Szedon, J.R.; Shirland, F.A.; Stoll, J.A.; Dickey, H.C. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 31 Mar 1980. Contract AC02-77CH00178. 32p. NTIS, PC A03/MF A01.

Two differences have been found in comparisons of CdS films deposited by single-source and four source methods: the latter show evidence of greater structural imperfection at the grain level and produce cells which develop nearly full photovoltaic performance after much shorter air heat treatment at 250°C than do cells in single-source material. A model is proposed to account for the greater structural disorder in the multi-source films. Cells fabricated by the IEC method on single source CdS films deposited on copper with a thin (0.3 μm) zinc plating have exhibited 3.3% efficiency, with improvement to be expected by optimized annealing.

4657 (SERI/TR—751-652) Photovoltaics information user study. Belew, W.W.; Wood, B.L.; Marie, T.L.; Reinhardt, C.L. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1980. Contract AC02-77CH00178. 221p. NTIS, PC A10/MF A01.

The results of a series of telephone interviews with groups of users of information on photovoltaics (PV) are described. These results, part of a larger study on many different solar technologies, identify types of information each group needed and the best ways to get information to each group. The report is 1 of 10 discussing study results. The overall study provides baseline data about information needs in the solar community. It covers these technological areas: photovoltaics, passive solar heating and cooling, active solar heating and cooling, biomass energy, solar thermal electric power, solar industrial and agricultural process heat, wind energy, ocean energy, and advanced energy storage. An earlier study identified the information user groups in the solar community and the priority (to accelerate solar energy commercialization) of getting information to each group. In the current study only high-priority groups were examined. Results from seven PV groups respondents are analyzed in this report: DOE-Funded Researchers, Non-DOE-Funded Researchers, Researchers Working for Manufacturers, Representatives of Other Manufacturers, Representatives of Utilities, Electric Power Engineers, and Educators.

4658 (SLU-IVL—107) Wood properties of Salix caprea and Salix pentandra. Sennerby, L. (Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Virkeslaera). 1979. 83p. (In Swedish). NTIS, PC A05/MF A01.

Salix caprea and Salix pentandra have been investigated with regard to the qualities and the anatomy of wood in these species. The type and distribution of cells, cell wall thickness, cell diameter and differences between early-and late wood cells in one annual ring have been studied. The specific gravity was determined through measuring the oven dry weight and the green volume of the samples and is given in kg/m^3. The length of fibers (that is tracheids, fiber tracheids and libriform fibers) in S.caprea and S.pentandra fluctuates between 0.5 to 1.1 mm and the length of vessels varies between 0.3 to 0.6 mm. There is a gradient in that the length of the cells increases from the pit towards the cambium in the cross-section of the wood. The variation in the stem shows an increase in cell-length from the stump to breast-height (1.3 m) and then the cells become shorter again. There was no significant difference to be found in this respect between the two species investigated. One-year-old sprouts of S.capres, S.viminalis, S.fragilis, and S.smithiana have been investigated with regard to specific gravity, moisture quotient, bark percentage, and the constitution of vessel members and fibers.

4659 (SLU-RIC—49) Investigation - biomass. Svensson, I. (Sveriges Lantbruksuniversitet, Alnarp. Research Information Centre). May 1979. 56p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01.

The requirements for agro-forestry are discussed. It is pointed out that the atmospheric precipitation has to be over 500 mm per year, ground water should exist at on average depth of 40 cm, the depth of soil has to be 70 cm and the ground must not incline more than 20%. It has been estimated that in Sweden there is maximum of 3×10^6 ha of ground which could be used for energy production forests. The environmental consequences of a very intense forest growing for the hydrology for other plants, for animals and insekts are discussed, and also the conflicts between different possibilities to use the ground.

4660 (STU—78-5376) Pressing of bark. Beyer, G. (Svenska Traeforskningsinstitutet, Stockholm (Sweden)). Apr 1980. 55p. (In Swedish). NTIS, PC A04/MF A01.

A high percentage of moisture in bark makes it less attractive as a fuel because the calorific value decreases as well as the efficiency of balers. The most widely used method to lessen the percentage of moisture is to press the bark. Usually a dry content of 40% is achieved. In this report laboratory experiments to improve the pressing methods are described. It was found that storage time, way of storage, and season influenced the properties of the bark. hence it was difficult to get reproducible tests. However a few tendencies were demonstrated: higher dry content is achieved with slow pressing than with fast; the pressure can vary between 2 and 6 MPa without influencing the result; sodium carbonate lowers surface tension; repeated pressing or higher temperature do not seem to influence the result; poorer results are achieved with bark from timber that has been stored in the sea; better results can be achieved by stack storage a short time before pressing; and good results have been achieved with roller press.

4661 Comparison of the interface energetics for n-type cadmium sulfide/ and cadmium telluride/nonaqueous electrolyte junctions. Aruchamy, A.; Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge). *USJournal of Physical Chemistry, The (U.S.);* **84**: No. 22, 2848-2854(30 Oct 1980).

Interface energetics for n-type CdS (E/sub g/ = 2.4 eV) and CdTe (E/sub g/ = 2.4 eV) have been compared in CH_3CN/0.1 M $[n\text{-}Bu_4N]ClO_4$ solutions containing low concentrations of fast, one-electric reagents having a wide range of formal potential, E^0. We find that n-type CdTe is blocking to the (dark) oxidation of the reduced form of any couple having E^0 in the range -2.0 to +0.7 V vs SCE. Illumination of the CdTe with ≧ E/sub g/ light, however, results in the oxidation of the reduced form of the couple and the photoanodic peak occurs ~ 0.6 V more negative than the anodic peak at a reversible electrode such as Pt. The ~ 0.6 V more negative anodic current peak is a measure of the open-circuit photovoltage that would be expected for an n-type CdTe-based photoelectrochemical cell employing some A+/A redox couple. A significant and essentially constant photovoltage independent of the E^0 of the couples studied leads to the conclusion that Fermi level pinning occurs for n-type CdTe/liquid junctions, as is also found for n-type CdTe/metal Schottky barriers. The crucial findings is that a photovoltage, insensitive to E^0, is found for redox couples having E^0's that span a range of potential greater than the separation of the valence and conduction band, E/sub g/. Fermi level pinning refers to a semiconductor/liquid or metal interface where photovoltage is insensitive to the contacting material. The effect is brought about by a sufficiently large density of surface states. By way of contrast, data for n-type CdS are consistent with those previously reported and indicate that CdS behaves as would be expected for a semiconductor essentially free of surface states. Photovoltage does depend on the E^0 of the contacting couple; only E^0's positive of the flat-band potential, E/sub FB/ ≃ -1.0 V vs SCE, give a photovoltage.

4662 Review of amorphous and polycrystalline thin film silicon solar cell performance parameters. Charles, H.J. Jr.; Ariotedjo, A.P. (PRC Energy Anal Co, McLean, Va). *US-Solar Energy. Journal of Solar Energy Science and Engineering (U.S.);* **24**: No. 4, 329-339(1980).

This paper presents a state-of-the-art technology review for amorphous and polycrystalline thin film silicon solar cells. It details the performance parameters for the diversity of cell types and structures fabricated with amorphous and polycrystalline silicon film materials. The type and format of performance data are identified so that comparisons between devices with different cell structure can be made. Trends in performance improvement and fabrication techniques are also traced. Comprehensive reference lists for both amorphous and polycrystalline silicon are also given. 40 refs.

4663 New technologies for solar energy silicon: cost analysis of BCL process. Yaws, C.L.; Li, K.Y.; Fang, C.S.; Lutwack, R.; Hsu, G.; Leven, H. (Lamar Univ, Beaumont, Tex). *USSolar Energy. Journal of Solar Energy Science and Engineering (U.S.);* **24**: No. 4, 359-365(1980).

New technologies for producing polysilicon that are developed to provide lower cost material for solar cells which convert sunlight into electricity are reviewed. This article presents results for the BCL Process (Battelle Columbus Laboratories), which produces the solar-cell silicon by reduction of silicon tetrachloride with zinc vapor. Cost, sensitivity and profitability analysis results are presented based on a preliminary process design of a plant to produce 1000 metric tons/year of silicon by the BCL Process. 46 refs.

4664 Analytical evaluation of a solar thermophotovoltaic (TPV) converter. Edenburn, M.W. (Sandia Lab, Albuquerque, NM). *USSolar Energy. Journal of Solar Energy Science and Engineering (U.S.);* **24**: No. 4, 367-371(1980).

The parametric analysis of a thermophotovoltaic converter presented considers emitter temperature, cell reflectance to radiation with energy below the cell's bandgap energy, and concentration ratio requirements. The concentration ratio is considered to determine its influence on converter performance. Important conclusions are that an emitter temperature near 2000 K is optimal; a cell reflectance value of 0.98 is required for below-bandgap irradiation; a secondary concentrator must be used with a parabolic-dish primary; and a mirror quality resulting in a 4-mrad reflected-beam dispersion is required for a 24 per cent conversion efficiency. 3 refs.

4665 **Plants as a source of high energy liquid fuels.** Nemethy, E.K.; Otvos, J.W.; Calvin, M. (Univ. of California, Berkeley). *USAmerican Chemical Society, Division of Fuel Chemistry, Preprints (U.S.);* **25**: No. 4, 216-220(1980). (CONF-800814—P3).

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

4666 **Integrated approach to the conversion of lignocellulose from wood into useful chemicals.** Goldstein, I.S. Raleigh, NC; North Carolina State University (1980). 29p. (NP—25150).

The use of strong hydrochloric acid (30%) for prehydrolysis of hemicelluloses followed by the use of superconcentrated hydrochloric acid (>40%) for hydrolysis of cellulose permits the separation of the three major hardwood components into separate xylose and glucose streams and a reactive lignin in high yield. Computer aided preliminary process design and economic analysis of an integrated plant producing ethanol, furfural, acetic acid and a reactive lignin residue predict an after tax return on investment of 16% and provide sensitivity analyses of impotant operating variables.

4667 **Solar thermoelectric energy conversion.** Benson, D.K.; Jayadev, T.S. (Sol Energy Res Inst, Golden, Colo). *USProceedings, Intersociety Energy Conversion Engineering Conference (U.S.);* **2**: No. 79CH1477-9, 1825-1830(1979). (CONF-790803—).

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

The use of thermoelectric energy conversion for solar applications is reexamined in the light of recent improvements in thermoelectric materials and the possible coupling to economical solar collectors. Solar thermoelectric energy conversion is shown to have several technical and possible economic advantages in applications which make use of low cost solar collectors with inherent thermal storage such as solar ponds and ocean thermal gradients. Two particular applications are discussed--an agricultural irrigation system using a solar pond collector and thermoelectric powered pump, and a large, base load ocean thermal energy conversion system using thermoelectric converters. 17 refs.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 4629, 4651, 4657

4668 **(PB—80-174386) Review of the economics of photovoltaic power systems. Final report.** Wolf, M.; Noel, G.T. (Moore School of Electrical Engineering, Philadelphia, PA (USA). Dept. of Electrical Engineering and Science). 27 May 1977. 128p. NTIS, PC A07/MF A01.

The objective of this project was to review and evaluate the current state of knowledge regarding the economics of photovoltaic power systems and their components. In performing this evaluation, special attention was given to identifying the major factors which affect economic parameters, to identifying and evaluating fundamental limitations which might limit the potential for cost reduction, and to assessing the projected costs of photovoltaic power generating systems. The fundamental lower cost limits for many types of photovoltaic cells were found to be adequately low. However, there was some concern expressed about the ultimately achievable cost levels for the complete, operative systems.

1407 Solar Thermal Power Systems

4669 **(ALO—3985-1) Solar total energy: large scale experimental at Shenandoah, Georgia. Phase III. Preliminary design. Final report, October 1, 1977-July 31, 1978.** (General Electric Co., Philadelphia, PA (USA). Space Div.). Sep 1978. Contract AC04-77ET20260. 567p. NTIS, PC A25/MF A01.

Portions of document are illegible.

The basic function of the STES at Shenandoah is to supply the electric power, process steam, and space heating and cooling demands of the expanded 3900 square meters (42,000 ft^2) Bleyle Plant and for the STES Mechanical Building. The Bleyle factory, initially equipped with its own independent (conventional) energy source, will derive at least 60% of its annual energy needs from the sun when the solar energy system becomes operational in the first quarter of 1981. The design and systems analysis of the STES are detailed. The Solar Collection Substation consists of an array of 192 seven meter diameter, parabolic dish collectors which provide a temperature rise to a flow of Syltherm 800 fluid through each collector in a parallel closed, hydraulic circuit. The receiver is a cavity type with the incident concentrated solar flux impinging upon an absorptive surface enclosed within an insulated cylindrical shell. The trickle oil/dual media concept was selected for the high temperature storage system. The Power Conversion Subsystem consists of a three piece pool-type boiler with preheater, boiler, and superheater, a GFE steam turbine-generator set rated at 400kWe supplied by Mechanical Technology, Inc., a condenser and condensate storage tank, make-up demineralizer, deaerating heater, and boiler feed pump. In normal operation, steam at 655°K (720°F) and 4.8 x 10^6 N/m^2 (700 psig) is generated in the boiler-super-heater, heated by Syltherm 800, and delivered to the turbine inlet. The Thermal Utilization Subsystem major components include a 2.1 x 10^{10} Joule (20 MBtu) capacity, sensible heat water, low temperature storage (LTS) subsystem, a 1.25 x 10^6 Joules/second (354 ton) absorption chiller derated to provide 6.09 x 10^5 Joules/second (173 tons) with inlet hot water at 372°K (210°F), and two separate cooling towers for heat rejection from both the absorption chiller and the PCS condenser. (WHK)

4670 **(EUR—6747EN) EURELIOS: the 1 MWe experimental solar thermal electric power plant of the European Economic Community. Summary of the final report on Phase B, 15 November 1977-15 November 1978.** (Commission of the European Communities, Luxembourg). 1980. 28p. NTIS (US Sales Only), PC A03/MF A01.

The design of the planned 1-MWe tower focus power plant to be built in Sicily, Italy, is described. The heliostat array, central receiver, steam power system, and molten salt heat storage system are described. A construction time schedule is included; start-up is planned for the summar of 1980. (WHK)

4671 **(GA-A—15408(DRAFT)) Line focus solar central power systems. Phase I. Midterm topical report, September 30, 1978-March 31, 1979.** (General Atomic Co., San Diego, CA (USA)). May 1979. Contract AC03-78ET20535. 203p. NTIS, PC A10/MF A01.

This progress report describes a conceptual design study of a 100-MW(e) Line Focus Solar Central Power System. The design embodies a field of fixed mirror solar concentrators (FMSCs) having a total aperture area of 7.6 million ft^2. Various heat transport fluids were studied, and draw salt was selected with operating temperatures of 550°F (feed) and 1050°F (delivery). Various receiver drive support and actuating mechanisms were studied to achieve improved performance/cost over the reference design. Various FMSC panel fabrication methods were investigated; concrete was retained as the reference structural material. The entire plant was modeled with respect to cost and performance, and cost optimization studies were conducted leading to the selection of a concentration factor of 71. A steam turbine with a single reheat operating at 1000°F/1000°F superheat/reheat temperature and 2400-psi throttle pressure was selected. Thermal storage options were evaluated, and the choice was separate hot and warm tanks of molten draw salt rather than either pure or rock-filled thermoclines.

4672 (SAND—80-8040) Thermophysical properties of the equimolar mixture $NaNO_3$-KNO_3 from 300 to 600°C. Nissen, D.A. (Sandia National Labs., Livermore, CA (USA)). Nov 1980. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01.

The equimolar molten salt mixture $NaNO_3$-KNO_3 is being proposed as a heat-transfer fluid and thermal-energy storage medium for various solar energy applications. In these applications the maximum operating temperature will be in the range 500 to 600°C. Industrial experience and previous experimental investigations on this molten salt mixture have generally been confined to temperatures below 450°C. In order to provide data to solve various specific design problems associated with the use of these molten nitrate salts as heat transfer fluids, it is important to know how the physical properties of these salts are affected by temperature and composition of the liquid and gas phases. The viscosity, surface tension, and density data measured over the temperature range 300 to 600°C are presented and discussed.

1408 Ocean Thermal Gradient And Salinity Gradient Power Systems

4673 (ANL/OTEC-BCM—010) Antifouling marine concrete. Vind, H.P.; Mathews, C.W. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Jul 1980. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01.

Various toxic agents were evaluated as the their capability to prevent or inhibit the attachment of marine fouling organisms to concrete. Creosote and bis-(tri-n-butyltin) oxide (TBTO) were impregnated into porous aggregate which was used in making concrete. Cuprous oxide, triphenyltin hydroxide (TPTH), and 2-2-bis-(p-methoxyphenyl)-1,1,1-trichloroethane (methoxychlor) were used as dry additives. Two proprietary formulations were applied as coatings on untreated concrete. Test specimens were exposed at Port Hueneme, CA, and Key Biscayne, FL. The efficacy of toxicants was determined by periodically weighing the adhering fouling organisms. Concrete prepared with an aggregate impregnated with a TBTO/creosote mixture has demonstrated the best antifouling performance of those specimens exposed for more than one year. The two proprietary coatings and the concrete containing methoxychlor, TPTH, and cuprous oxide as dry additives have exhibited good antifouling properties, but they have been exposed for a shorter time. The strength of concrete containing the toxicants was acceptable, and the toxicants did not increase the corrosion rate of reinforcing rods. Organotin compounds were essentially unchanged in concrete specimens exposed 6 1/2 years in seawater.

4674 (ANL/OTEC-BCM—011) Micro- and macrofouling in the OTEC program: an overview. Mitchell, R.; Benson, P.H. (Argonne National Lab., IL (USA); Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences). Jun 1980. Contract W-31-1090-ENG-38. 51p. NTIS, PC A04/MF A01.

The mechanism of formation and environmental factors affecting marine biofouling are reviewed. Methods of biofouling assessment, known and potential biofouling impacts upon plant performance, and control measures applicable to OTEC are also discussed. Areas of uncertainty and the needs for continuing R and D effort to resolve such issues are indicated.

4675 (DOE/ET/20325—T1) Design, test and commercialization considerations of OTEC pilot plant riser cables. Garrity, T.F.; Eaton, R.; Dalton, T.; Pieroni, C.; Walsh, J.P. (Simplex Wire and Cable Co., Portsmouth, NH (USA)). 1980. Contract AC05-77ET20325. 12p. NTIS, PC A02/MF A01.

Discussion addresses riser cable system development for OTEC pilot plants transmitting power in the range of 10 to 40 MW. Specifically, design, testing and status of riser cable system development are reviewed. Further discussion encompasses unique technical, hardware and operational considerations associated with the commercialization of riser cable systems.

4676 (DOE/ET/20325—T2) Mechanical design of submarine power cables for floating platforms. Bisplinghoff, R.L.; Libby, D.O.; Costantino, R.W. (Simplex Wire and Cable Co., Portsmouth, NH (USA)). 1980. Contract AC05-77ET20325. 10p. NTIS, PC A02/MF A01.

Portions of document are illegible.

The process of mechanical design of submarine power cables employed by the Simplex Wire and Cable Company is described. The process commences with design criteria and proceeds through preliminary design, load and stress analyses and culminates in extreme value reliability and lifetime predictions. The analytical methods employed are emphasized and some representative numerical results are presented.

4677 (DOE/ET/20325—T3) Electrical/mechanical evaluation of high voltage dielectrics for OTEC riser cables. Traut, R.T.; Kurt, J.P.; DiPietro, F.M.; Roberts, K.P. (Simplex Wire and Cable Co., Portsmouth, NH (USA)). 1980. Contract AC05-77ET20325. 5p. NTIS, PC A02/MF A01.

The unique design and test requirements for the cable dielectrics selected for evaluation for use in Ocean Thermal Energy Conversion plants are described. Specifically, the methodology of developing the test procedure is defined. The basic cable dielectrics selected for evaluation include taped/oil-impregnated insulation, and extruded solid cross-linked polyethylene insulation. These cables are designed to transmit 100 MW at 138 kV, and will be subjected to installation and operating conditions that are unprecedented for any power cable system. These conditions include ocean depths of 4000 to 5000 feet, long vertical suspension, and the motions and forces imparted by the plant and ocean. The developmental test program is designed primarily to determine the weak link in the components of the candidate cable with regard to the ability to successfully withstand the unusual OTEC conditions over a 10 to 30 year lifetime. Two basic areas of concern are the mechanical fatigue of metallic sheaths and strength members, and the electrical/mechanical "fatigue" of the dielectric and shielding components. The constraints and problems in such testing are addressed, and the engineering solutions are described. Finally, the scheduled plan for completion of the entire development test plan is defined.

4678 (LBL—10887) Status of OTEC environmental monitoring program. Wilde, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 10p. (CONF-800633—4). NTIS, PC A02/MF A01.

From 7. ocean energy conference; Washington, DC, USA (2 Jun 1980).

Oceanographic studies in support of assessment and technical operations for Ocean Thermal Energy Conversion (OTEC) have been conducted in the South Atlantic Plant-ship region and at benchmark sites off Puerto Rico, the Gulf of Mexico and off Hawaii. Data have been obtained from current meter arrays, hydrocasts, and net tows using essentially the same type of equipment, sample depths, sample frequencies, techniques and analyses to provide a uniform basis of comparison among the sites. In addition, particulate, trace metal, and radiologic studies off St. Croix, Virgin Islands and primary production bioassay experiments off Hawaii were performed to validate methods and a bottom assessment program is being developed in cooperation with the US Geological Survey for potential incorporation into the uniform sampling program. Environmental monitoring operations at the OTEC-1 site off Hawaii have been transferred to EG & G and the Hawaiian pre-site occupation program has been shifted to the Kahe Point area off the west coast of Oahu. Validated data from the OTEC cruises are on file with National Oceanographic Data Center (NODC). These data are being used with the Argonne National Laboratory (ANL) developed physical models to jointly test potential ecologic models for use in pilot plant assessments. Marine geologic/oceanographic base maps and data compilation sheets were prepared for the Hawaiian and Puerto Rico-Virgin Island regions. Such sheets form a planning base for evaluation of regional characteristics and to identify areas for detailed surveys.

1409 Solar Thermal Utilization

4679 (DOE/CR/10001—T2) Review of activities and plans for solar energy in Federal buildings. (Computer Sciences Corp., Vienna, VA (USA). Systems Div.). Oct 1980. Contract AC01-79CR10001. 35p. NTIS, PC A03/MF A01.

The purpose of this report is to provide the Department of Energy's Solar Federal Buildings Program with data on the Federal agencies' activities and plans regarding the use of solar energy in their buildings, and consequently, to make recommendations concerning the Solar Federal Buildings Program's plans. Specifically this report encompasses an analysis of agencies Ten Year Buildings construction, leasing and retrofit plans to provide visibility for and detailed knowledge of Federal agencies planning regarding solar and other renewable energy resources. The results of the analysis conducted, pertinent statistical information regarding planned solar projects, and recommendations concerning the SFBP plans are presented.

4680 (DOE/CS/35405—T1) Optimization of storage in passive solar heating systems. Final report. Bahm, R.J. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). May 1980. Contract AS04-78CS35405. 215p. NTIS, PC A10/MF A01.

The search for a simple method of estimating the optimum amount of storage for passive solar space heating system designs and the results of that search are described. The project goals, and why the project is important are described. The major project results are presented in the order of their importance with respect to meeting the project goal. A narrative description of the project is given. Here the various approaches attempted are described, giving the reasons for failure in those areas that were not successful. The Appendices contain the bulk of data generated by this project. Most of the data is presented in graphical form. (MHR)

4681 (DOE/NASA/CR—161586) Solar heating system installed at Jackson, Tennessee. Final report. (Energy Solutions, Inc., Memphis, TN (USA)). Oct 1980. Contract FG04-77CS34092. 159p. NTIS, PC A08/MF A01.

The solar energy heating system installed at the Coca-Cola Bottling Works in Jackson, Tennessee is described. The system consists of 9480 square feet of Owens-Illinois evacuated tubular solar collectors with attached specular cylindrical reflectors and will provide space heating for the 70,000 square foot production building in the winter, and hot water for the bottle washing equipment the remainder of the year. Component specifications and engineering drawings are included. (WHK)

4682 (DOE/NASA/CR—161587) Solar hot water system installed at Mobile, Alabama. Final report. (La Quinta Motor Inns, Inc., San Antonio, TX (USA)). Oct 1980. Contract FG01-77CS31623. 27p. NTIS, PC A03/MF A01.

This final report describes the solar energy hot water system installed at LaQuinta Motor Inn Inc., at Mobile, Alabama. The building is a 122 unit motel. The system consists of six rows of ten collectors and three rows of eleven collectors (1990 square feet) mounted on the roof. Griswald flow control valves were installed to regulate the flow to each row. Two Heliotrope electronic thermometers with a combined capability of measuring the temperatures of 22 different locations were installed for monitoring purposes. Engineering drawings, component specifications, and operator instructions are included.

4683 (DOE/NASA/CR—161588) Solar heating system installed at Troy, Ohio. Final report. (Troy-Miami County Library, OH (USA)). Sep 1980. Contract AC01-76CS32375. 276p. NTIS, PC A13/MF A01.

This document is the Final Report of the Solar Energy System located at Troy-Miami County Public Library, Troy, Ohio. The completed system is composed of tree basic subsystems: the collector system consisting of 3264 square feet of Owens Illinois evacuated glass tube collectors; the storage system which includes a 5000-gallon insulated steel tank; and the distribution and control system which includes piping, pumping and control logic for the efficient and safe operation of the entire system. This solar heating system was installed in an existing facility and is, therefore, a retrofit system. This report includes extracts from the site files, specifications, drawings, installation, operation and maintenance instructions.

4684 (LA-UR—80-2930) Study of the effectiveness of selective absorber coatings and phase change materials in passive solar space heating. Wray, W.O.; Hyde, J.C.; Bourdeau, L.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800972—6). NTIS, PC A02/MF A01.

From 1980 Department of Energy passive and hybird solar energy program update meeting; Washington, DC, USA (21 Sep 1980).

The project reported had two primary objectives. The first objective was to assess the performance of selective absorber coatings in passive solar heating systems. The relative performance of thermal storage wall buildings when equipped either with a selective absorber coating or movable night instulation was studied. The second objective was to determine what advantages, if any, a phase change thermal storage wall might have over a conventional system that employs either masonary or water as the thermal storage medium. Phase change material (PCM) walls were tested with and without a diatomaceous earth thickening agent that suppresses convection and in both vented and unvented configurations. Results are presented and discussed.

4685 (LA-UR—80-3397) International comparison of passive solar simulation codes. Wray, W.O. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-801218—1). NTIS, PC A02/MF A01.

From Colloque solaire international; Nice, France (11 Dec 1980).

Two software-software comparisons of passive solar simulation codes have been conducted by the Passive Solar Applications Group of the Committee on the Challenges to Modern Society. These exercises have involved the simulation of hypothetical Trombe wall and direct gain buildings located in Madison, Wisconsin. The countries that have participated in the exercise include Canada, Denmark, France, and the United States. All results available at the time of writing are discussed in this report.

4686 (NCEI—0023) Utilization of solar energy in grain drying. Final report, June 1978-June 1979. Ozisik, M.N.; Huang, B.K. (North Carolina State Univ., Raleigh (USA)). Jul 1979. 33p. NTIS, PC A03/MF A01.

Equipment was designed and constructed for use with an existing greenhouse solar drying system (solar barn) to study the utilization of solar energy for peanut curing under the conditions prevailing in North Carolina. The basic equipment consists of a rotary solar drum unit which holds about six tons of peanuts and a trailer unit which transport the drum and peanuts. The unique features of the prototype are that the perforated sheet metal surfaces and the dryer unit itself serves partly as a solar heat absorber/collector during drying mode operation and that the circumferential surface of the rotary drum unit can be disassembled and hung on the drum frame to serve as a ferris wheel plant production system during greenhouse mode operation. The design will provide multi-purpose utilization of the facilities enhancing the economic feasibility of the system. Four full-scale tests were performed for peanut drying using both solar and furnace heating. No-load tests were also performed for system performance study. Computer simulation programs were developed to correlate the measured data and the mathematical model prediction. The heat and mass transfer analysis of solar air heating and grain drying for the prototype model is described and the results of a parameter survey showing the effects of various system parameters on drying time are presented.

4687 (SAND—79-2173) Handbook for calculating solar-influenced building heat losses. Harrigan, R.W.; Anderson, H.E.; Hall, I.J. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 181p. NTIS, PC A09/MF A01.

Monthly heat losses and gains are presented for single-pane windows having different orientations. In additions, computational techniques in both analytical and graphical form are presented to

extend this information to the computation of heat losses and gains from other building elements and the evaluation of wind speed on building heat loss. Heat lose data is presented for 26 SOLMET sites. An example problem illustrates the computations involved.

4688 (SERI/PR—721-788) Program area plan. Performance evaluation of passive/hybrid solar heating and cooling systems. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1980. Contract AC02-77CH00178. 199p. NTIS, PC A09/MF A01.

The primary objective of the Passive and Hybrid Systems Performance Evaluation Program is to support both system development and market development for passive and hybrid heating and cooling systems through a nationally coordinated program of quantitative and qualitative performance evaluation. The objectives of the plan, both generally and in terms of meeting the highest priority data needs of the various end uses and end users of performance evaluation data are defined. The issue of acquiring data on highest priority combinations of system types, locations, applications, and costs for various potential end users is addressed. A strategy is proposed to balance data needs with the resources available. Data needs are organized and matched to data sources, specifically Test Rooms and Class A, B, and C Monitored Buildings. Projected numbers of sites for each type of data source and projected uses of these various data sources for prototype testing in support of specific system development activities are given through FY 1984. Data acquisition in support of market development is also described followed by a proposed management strategy for the entire program. The technical and management methods to be employed to implement the program at each level of performance evaluation are presented, and specific tasks to be performed during FY 1981 and FY 1982 are discussed. (WHK)

4689 (SOLAR/1011—80/14) Solar energy system performance evaluation, Albuquerque Western 1, Albuquerque, New Mexico. October 1979 through March 1980. Evans, K.D. (Automation Industries, Inc., Richland, WA (USA). Vitro Engineering Div.). 1980. Contract AC01-79CS30027. 74p. NTIS, PC A04/MF A01.

This 101-unit apartment building in Albuquerque, New Mexico uses 2478.4 ft^2 of tracking concentrating collectors and a 1740 gallon cylindrical storage tank to preheat domestic hot water. Various problems caused a 14% solar fraction rather than the predicted 50%. (MHR)

4690 (SOLAR/1044—80/14) Solar energy system performance evaluation, Mat Cannon, Gainesville, Florida. December 1979 tthrough March 1980. Whitehead, C.Y. (Automation Industries, Inc., Richland, WA (USA). Vitro Engineering Div.). 1980. Contract AC01-79CS30027. 92p. NTIS, PC A05/MF A01.

The Matt Cannon site is a four-unit, two-story apartment building in Gainesville, Florida which has 597 ft^2 of flat plate collectors and a 1000-gallon storage tank for space and water heating of the 2420 ft^2 of conditioned space. The system supplied 62% of the space heating load and 50% of the domestic hot water load. The storage subsystem performance was poor. (MHR)

4691 Heat pump and thermal storage system for solar heating and cooling based on the reaction of calcium chloride and methanol vapor. Offenhartz, P.O'D.; Brown, F.C.; Mar, R.W.; Carling, R.W. (EIC Corp, Newton, Mass). *USTransactions of the ASME (American Society of Mechanical Engineers) (U.S.);* **102**: No. 1, 59-65(Feb 1980).

Thermodynamic, kinetic, heat transfer and mass transfer data are presented on the reaction of calcium chloride and methanol vapor to form solid-phase substances. These data demonstrate the suitability of the reaction for storing solar energy, and for pumping heat, either for use in space heating air conditioning, or both. In the heating mode, chemical heat pumps using a solar source can amplify the output of a solar collector, increasing its effective efficiency for space heating applications. 15 refs.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 4651, 4703

4692 Incidence-angle modifier and average optical efficiency of parabolic trough collectors. Gaul, H.; Rabl, A. (Sol Energy Res Inst, Golden, Colo). *USTransactions of the ASME (American Society of Mechanical Engineers) (U.S.);* **102**: No. 1, 16-21(Feb 1980).

The incidence-angle modifier for parabolic troughs is investigated in order to clarify the connection between collector tests and prediction of long-term energy delivery by collector arrays. The optical efficiency of a parabolic trough collector decreases with incidence angle for several reasons: the decreased transmission of the glazing and the absorption of the absorber; the increased width of the solar image on the receiver; and the spillover of the radiation from troughs of finite length. The results are presented in two forms: as a polynomial fit to the data; and as a single number, the all-day average optical efficiency for typical operating conditions. 11 refs.

4693 (DOE/CS/15367—T2) Heat conduction in partial vacuum. Final technical progress report. Thomas, J.R. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Coll. of Engineering). Sep 1980. Contract AC04-78CS15367. 50p. NTIS, PC A03/MF A01.

Methods developed for computing conduction heat losses from evacuated solar collectors are reported. Results of such calculations are given, including the minimum vacuum necessary to effectively eliminate conduction. Experiments performed at Owens-Illinois, Inc. to assess helium penetration rates into evacuated collectors are analyzed, and estimates are given as to the likely penetration rate of atmospheric helium. Conclusions are drawn as to the probable effect of helium penetration on the lifetimes of evacuated solar collectors.

4694 (DOE/CS/34299—T1) Selective IR reflective coatings development. Final report, 24 July 1978-24 October 1979. Lefkow, A.R.; Lee, J.C. (Honeywell, Inc., Minneapolis, MN (USA). Systems and Research Center). Oct 1979. Contract AC04-78CS34299. 64p. NTIS, PC A04/MF A01.

The objective of this program is to develop selective infrared (IR) reflective solar transparent coatings for use on plastic glazing materials. The coating systems studied for this application were indium-tin oxide, tin oxide, and antimony-doped tin oxide. These semiconductor thin films were deposited by two plasma-assisted deposition techniques, ion plating and chemical vapor plasma deposition (CVPD), in which electron kinetic energy from the plasma mitigates the high substate temperature usually required to achieve sufficient thin film crystallinity. The best coating performance obtained in the program by these approaches was 80 to 85% solar transmission and 35% (at 10 microns) to 50% (at 40 microns) IR reflectance for $Sb:SnO_2$ films plasma-deposited from $Sn(CH_3)_4$ and $SbCl_5$ vapor sources. This is not thought to be the ultimate performance achievable for CVPD-grown $Sb:SnO_2$ films.

4695 (PNL—3575) Adhesion and chemical vapor testing of second surface silver/glass solar mirrors. Dake, L.S.; Lind, M.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 63p. NTIS, PC A04/MF A01.

Second surface silvered glass mirrors supplied by four different commercial manufacturers were evaluated for silver-to-glass adhesion and resistance to chemical vapor attack. The mirrors were chemically silvered on identical substrates of low iron float glass. Experiments were performed in order to assess the viability of using adhesion and chemical attack as screening tests for predicting the relative long-term durability of solar mirrors. The results of these tests will be compared at a future time with the survivability of field mirrors deployed in stationary exposure racks at ten locations throughout the United States. The adhesion tests were performed using a commercially-available thin film tensile pull tester in which a stud bonded to the film is pulled and the yield load recorded. Numerous subtleties regarding the selection of the adhesive used to bond the study and the validity of the testing procedure are

discussed. Several different methods of normalizing the results were attempted in an effort to reduce the scatter in the data. The same set of samples were exposed to salt spray, water, HCl, H_2SO_4, and HNO_3 vapors and then ranked according to their performance. Visual comparison of tested samples did not yield consistent results; however, definite trends were observed favoring one of the manufacturers. Some SEM/EDX analysis was performed on these mirrors subject to accelerated degradation in order to compare them to mirrors subject to natural degradation. However, insufficient data has been collected to show that any of the tests performed will accurately predict the relative life expectancy of the mirrors in an outdoor environment.

4696 **(PNL—3629) Alternate protection concepts for second surface silver/glass solar mirrors.** Buckwalter, C.Q.; Dake, L.S.; Hartman, J.S.; Lind, M.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1980. Contract AC06-76RL01830. 28p. NTIS, PC A03/MF A01.

Investigations into three technologies having the potential of significantly enhancing the durability of solar mirrors are reported. The approaches are based on the assumption that sealing the silver layer on second surface mirrors from the external environment with protective overcoats will significantly extend their useful service life. Considered are: (1) edge sealing a second sheet of glass over the silver layer using solder glasses, (2) overcoating the silver layer with liquid applied SiO_2 or TiO_2 coatings, and (3) overcoating the silver layer with an electroless nickel film. Preliminary experiments were performed using Sb_2O_5-K_2O and PbO based solder glasses to edge seal a second sheet of glass over the silver mirror surface. Problems encountered in the formulation of the Sb_2O_5-K_2O glasses forced abandonment of these low melting point solder glass experiments. Materials compatibility problems were encountered when using several of the commercially available PbO based solder glasses alternatives. A cursory evaluation of liquid SiO_2 and TiO_2 coatings was also undertaken. The films were applied as direct overcoats on both silver only and silver/copper mirror substrates. Although the process appeared to yield visually acceptable coatings, under microscopic examination the films were found to be porous and pinhole riddled after the final curing step. Consequently, they did not stand up well to salt spray and HCl vapor tests. Background data were collected in an investigation of overcoating the silver or silver/copper mirrors with an electroless deposited nickel film. Two formulations, one a basic solution, the other a commercial acidic solution, were attempted. Film integrity problems were encountered for fairly thick films in the feasibility experiments attempted. Nevertheless, the concept appears sound and merits further investigation.

4697 **(SAND—79-8185) Plastic film performance improvement for heliostats. Final report.** (Boeing Engineering and Construction Co., Seattle, WA (USA)). Jul 1980. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01.

A plastic film improvement program was initiated to improve the BEC enclosed heliostat design and hence its overall performance and cost effectiveness. An industrial survey was initiated. Suppliers were urged to participate by providing samples of materials they felt had potential. Suppliers were visited for technical discussions about their products and to become knowledgeable in the processes of plastic film manufacture. The preliminary candidate materials were screen tested in Boeing laboratories. The materials showing promise were sent to Phoenix for desert exposure testing. After 3 months of accelerated exposure, coupons were withdrawn and tested for degradation. The data were used to eliminate candidates of obvious poor weatherability, and assist the supplier in making modifications for possible second iteration materials. Exposure of first iteration materials continued while second iteration candidates (new materials and modified previously tested materials) were being made available. After 6 months of real time and accelerated exposure first iteration samples were withdrawn and returned for lab tests. Lab testing of second iteration materials were performed after 3 months of accelerated exposure. Exposure testing of the most promising materials will be continued after the end of this contract. Test results are presented.

4698 **(SAND—80-7002) Shenandoah solar collector.** (Kearney (A.T.), Inc., Los Angeles, CA (USA)). Sep 1980. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01.

The study was designed to meet the following objectives: 1) develop a cost estimate for manufacturing 124 Seven-Meter Parabolic Dish Solar Collectors to be installed at Shenandoah, Georgia; 2) make recommendations to lower the expenses of collector fabrications and overall project cost; 3) identify alternate sources for materials and sub-contracted services; and 4) provide detailed backup data to support all estimates. Results are presented. (WHK)

4699 **(SAND—80-7070) Solar collector foundation designs.** Auld, H.E.; West, J.B. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 37p. NTIS, PC A03/MF A01.

Foundation designs for a solar collector facility proposed for construction at Sandia Laboratories are presented. A suggested method for placement and construction is included. A cost estimate is provided in Appendix A and the complete design calculations are presented in Appendix B. (WHK)

4700 **(SERI/PR—731-931) Convecting solar pond experiments. Progress report for FY 1980.** Leboeuf, C.M. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1980. Contract AC02-77CH00178. 17p. NTIS, PC A02/MF A01.

The primary objective of this work is to determine the thermal, optical, and mechanical performance of several low-cost glazing and insulating materials in conjunction with a freshwater (convecting) solar pond. The effect of implementing a pond filtration system will also be examined. Progress is reported. Although actual pond performance data is not yet being collected, much progress has been made on this task during FY 1980. Several glazing materials were analyzed in various configurations and material properties of optical transmissivity and thermal conductivity were measured. In addition, the pond test facility was designed, constructed, and is nearly ready for testing the first surface treatment.

4701 **Measurement of heliostat performance characteristics.** Thornton, J.P.; Waddington, D. (Sol Energy Res Inst, Golden, Colo). *USTransactions of the ASME (American Society of Mechanical Engineers) (U.S.);* **102**: No. 1, 22-33(Feb 1980).

A key in the development of any solar collector is described as the comparison of actual performance data with predicted data. During a series of tests at the Martin Marietta solar test facility during 1976 and 1977, the performance of four full-size, prototype heliostats with different types and sizes of glass mirrors were measured and subsequently shown to compare closely with the predicted performances. 3 refs.

4702 **Sensitivity of solar transmittance, reflectance and absorptance to selected averaging procedures and solar irradiance distributions.** Lind, M.A.; Pettit, R.B.; Masterson, K.D. (Pac Northwest Lab, Richland, Wash). *USTransactions of the ASME (American Society of Mechanical Engineers) (U.S.);* **102**: No. 1, 34-40(Feb 1980).

The sensitivity of the solar weighted optical properties of selected materials to different terrestrial solar spectral irradiance distributions and computational techniques has been investigated. The spectral transmittance, reflectance, and absorptance of typical materials employed in solar thermal conversion systems were used for the calculations. The values obtained for several different solar irradiance distributions and calculational methods show only small differences. A single terrestrial solar irradiance distribution is recommended for use as a standard. 19 refs.

1420 Heat Storage

4703 **(ANL-CT—80-22) Heat loss modeling for the ANL Research Solar Pond.** Bartzis, J.G.; Domanus, H.M.; Sha, W.T. (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01.

An analytical capability has been developed based on using the COMMIX-SA-SP code to analyze the transient three-dimensional heat losses from an arbitrarily shaped solar pond. The COMMIX-SA-SP code is derived from the COMMIX-1A code. The analytical capability is demonstrated by calculating the heat

losses from the ANL Research Solar Pond, which is under construction in Argonne National Laboratory. The calculations show that the two-dimensional model underestimates the heat losses as compared with the three-dimensional model. The yearly average heat flux approaches to within 10% of the steady state value after approximately 5 years of operation. Weather changes during the year create flux changes up to 4 times the average value. An insulator with thermal conductivity to thickness ratio less than 0.12 W/ $m^2/°K$ can reduce the heat loss from a solar pond to soil by 50% or less.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

4704 **(DOE/ID/12018—5) Colorado Geothermal Commercialization Program.** Healy, F.C. (Colorado Geological Survey, Denver (USA)). Apr 1980. Contract FC07-79ID12018. 53p. NTIS, PC A04/MF A01.

Chaffee County, located in central Colorado, has immense potential for geothermal development. This report has been prepared to assist residents and developers in and outside the area to develop the hydrothermal resources of the county. Data has been collected and interpreted from numerous sources in order to introduce a general description of the area, estimate energy requirements, describe the resources and postulate a development plan. Electric power generation and direct heat application potential for the region are described.

4705 **(DOE/ID/12018—7) Colorado Geothermal Commercialization Program. Semi-annual report, January-June 1980.** Healy, F.C. (Colorado Geological Survey, Denver (USA)). Jul 1980. Contract FC07-79ID12018. 21p. NTIS, PC A02/MF A01.

Progress is reported on the following: geothermal leasing, outreach activities, and updating resource information. (MHR)

4706 **(DOE/TIC—11303) Comparative assessment of five potential sites for hydrothermal-magma systems: summary.** Luth, W.C.; Hardee, H.C. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01.

A comparative assessment of five potential hydrothermal-magma sites for this facet of the Thermal Regimes part of the CSDP has been prepared for the DOE Office of Basic Energy Sciences. The five sites are: The Geysers-Clear Lake, CA, Long Valley, CA, Rio Grande Rift, NM, Roosevelt Hot Springs, UT, and Salton Trough, CA. This site assessment study has drawn together background information (geology, geochemistry, geophysics, and energy transport) on the five sites as a preliminary stage to site selection. Criteria for site selection are that potential sites have identifiable, or likely, hydrothermal systems and associated magma sources, and the important scientific questions can be identified and answered by deep scientific holes. Recommendations were made.

4707 **(LA—8562-MS) Basic research needed for the development of geothermal energy.** Aamodt, R.L.; Riecker, R.E. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01.

Basic research needed to facilitate development of geothermal energy is identified. An attempt has been made to make the report representative of the ideas of productive workers in the field. The present state of knowledge of geothermal energy is presented and then specific recommendations for further research, with status and priorities, are listed. Discussion is limited to a small number of applicable concepts, namely: origin of geothermal flux; transport of geothermal energy; geothermal reservoirs; rock-water interactions, and geophysical and geochemical exploration.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 5319

4708 **Evaluation methods of heat discharge and their applications to the major active volcanoes in Japan.** Kagiyama, T. (Univ. of Tokyo, Bunkyo-ku, Japan). *NLJournal of Volcanology and Geothermal Research (Netherlands);* **9**: No. 1, 87-97(Jan 1981).

The rates at which thermal energy is released by non-eruptive mechanisms associated with active volcanoes in Japan have been estimated from surface temperature distributions or from shapes of the fumarolic plume rise. Values of 5.3×10^7 W and 1.2×10^8 W have been calculated for non-eruptive release rates in 100-km segments of the Northeast and the Southwest Japan Arc, respectively. It appears that non-eruptive heat discharge is of the same order as that caused by eruptions.

4709 **Quantitative simulation of the hydrothermal systems of crystallizing magmas on the basis of transport theory and oxygen isotope data: an analysis of the Skaergaard intrusion.** Norton, D. (Univ. of Arizona, Tucson); Taylor, H.P. Jr. *GBJournal of Petrology (England);* **20**: No. 3, 421-486(Aug 1979).

Application of the principles of transport theory to studies of magma-hydrothermal systems permits quantitative predictions to be made of the consequences of magma intruding into permeable rocks. Transport processes which redistribute energy, mass, and momentum in these environments can be represented by a set of partial differential equations involving the rate of change of extensive properties in the system. Numerical approximation and computer evaluation of the transport equations effectively simulate the crystallization of magma, cooling of the igneous rocks, advection of chemical components, and chemical and isotopic mass transfer between minerals and aqueous solution. Numerical modeling of the deep portions of the Skaergaard magma-hydrothermal system has produced detailed maps of the temperature, pressure, fluid velocity, integrated fluid flux, $\delta^{18}O$-values in rock and fluid, and extent of nonequilibrium exchange reactions between fluid and rock as a function of time for a two-dimensional cross-section through the pluton. An excellent match was made between calculated $\delta^{18}O$-values and the measured $\delta^{18}O$-values in the three principal rock units, basalt, gabbro, and gneiss, as well as in xenoliths of roof rocks that are now embedded in Layered Series; the latter were evidently depleted in ^{18}O early in the system's cooling history, prior to falling to the bottom of the magma chamber. The best match was realized for a system in which the bulk rock permeabilities were 10^{-13} cm^2 for the intrusion, 10^{11} cm^2 for basalt, and 10^{-16} cm^2 for gneiss; reaction domain sizes were 0.2 cm in the intrusion and gneiss and 0.01 cm in the basalts, and activation energy for the isotope exchange reaction between fluid and plagioclase was 30 kcal/ mole.

4710 **Andesites in island arcs and continental margins: relationship to crustal evolution.** Eichelberger, J.C. (Univ. of California, Los Alamos, NM). Contract W-7405-ENG-36. *ITBulletin Volcanologique (Italy);* **41**: No. 4, 480-500(1978).

Andesites of both island arc and continental margin environments contain petrologic evidence of mixing of mantle and crustal melts. Andesitic volcanism appears to involve addition of mantle-derived basaltic magma to the crust and fractionation of preexisting crustal material. Changes in andesitic volcanism with increasingly continental character of the crust reflect changes in a rhyolitic component derived from increasingly aged and fractionated crust. The initial stage in development of continental crust is partial melting of oceanic crust.

1503 Geothermal Exploration And Exploration Technology

4711 **(DOE/ET/27013—T1) Topical report on subsurface fracture mapping from geothermal wellbores. Phase I. Pulsed radar techniques. Phase II. Conventional logging methods. Phase III. Magnetic borehole ranging.** Hartenbaum, B.A.; Rawson, G. (H-Tech Labs., Inc., Santa Monica, CA (USA)). Sep 1980. Contract AC04-79ET27013. 139p. NTIS, PC A07/MF A01.

To advance the state-of-the-art in Hot Dry Rock technology, an evaluation is made of (i) the use of radar to map far-field fractures, (ii) the use of more than twenty different conventional well logging tools to map borehole-fracture intercepts, and (iii) the use of magnetic dipole ranging to determine the relative positions of the injection well and the production well within the fractured zone. It is found that according to calculations, VHF backscatter radar has the potential for mapping fractures within a distance of 50 +- 20 meters from the wellbore. A new technique for improving fracture identification is presented. Analyses of extant data indicate that when used synergistically the (1) caliper, (2) resistivity dipmeter, (3) televiewer, (4) television, (5) impression packer, and (6) acoustic transmission are useful for mapping borehole-fracture intercepts. Improvements in both data interpretation techniques and high temperature operation are required. The surveying of one borehole from another appears feasible at ranges of up to 200 to 500 meters by using a low frequency magnetic field generated by a moderately strong dipole source (a solenoid) located in one borehole, a sensitive B field detector that traverses part of the second borehole, narrow band filtering, and special data inversion techniques.

4712 **(LA-UR—80-3295) Detection of a thin sheet magnetic anomaly by squid-gradiometer systems: possibility of hydrofracture azimuth determination.** Overton, W.C. Jr. (Los Alamos Scientific Lab., NM (USA)). Dec 1978. Contract W-7405-ENG-36. 18p. (CONF-8006139—1). NTIS, PC A02/MF A01.

From Squid applications to geophysics workshop; Los Alamos, NM, USA (2 Jun 1980).

A study of the signal physics of magnetic anomaly detection was carried out by superconducting gradiometer and magnetometer loop systems with SQUID sensors for possible application to the LASL geothermal energy program. In particular, the crack produced by hydrofracture of a deep HDR geothermal borehole would be filled with a magnetic material such as ferrofluid. When polarized by the earth's field, this material would produce a localized crack magnetic anomaly which is characteristic of the azimuth of the vertical crack with respect to magnetic north. Signatures of the anomaly would be determined by taking rotation data before and after filling the crack with magnetic material. A mathematical description was found for these signatures. To test the theory and the feasibility of the idea, the deep borehole vertical cracks were simulated by using panels to define sheets 1.5 mm thick, 1.2 m wide, and 2.5 m high. When filled with ferrofluid of suitable magnetic permeability, the local anomaly develops. Signatures were measured with a horizontal axial gradiometer rotated about a vertical axis. Good agreement was found between theory and experiment for aximuths in the east and west quadrants but only fair agreement in the north and south quadrants.

4713 **(LBL—10140) Geothermal exploration assessment and interpretation, Upper Klamah Lake Area, Klamath Basin, Oregon.** Stark, M.; Goldstein, N.E.; Wollenberg, H.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1980. Contract W-7405-ENG-48. 89p. NTIS, PC A05/MF A01.

Data from public and private sources on the Klamath Basin geothermal resource are reviewed, synthesized, and reinterpreted. In this, the second and final phase of the work, geological, remote sensing, geochemical, temperature gradient, gravity, aeromagnetic, and electrical resistivity data sets are examined. These data were derived from surveys concentrated on the east and west shores of Upper Klamath Lake. The geological, remote sensing, and potential field data suggest a few northeast-trending discontinuities, which cross the regional north-westerly strike. The near-surface distribution of warm water appears to be related to the intersections of these lineaments and northwest-trending faults. The groundwater geochemical data are reviewed and the various reservoir temperature estimates compared. Particular attention is given to specific electrical conductivities of waters as an interpretational aid to the subsurface resistivity results. A clear trend emerges in the Klamath Falls/Olene Gap area; hotter waters are associated with higher specific conductivities. In the Nuss Lake/Stukel Mountain area the opposite trend prevails, although the relationship is somewhat equivocal.

4714 **Regional strategy for geothermal exploration with emphasis on gravity and magnetotellurics.** Aiken, C.L.V. (Univ. of Texas at Dallas, Richardson); Ander, M.E. *NLJournal of Volcanology and Geothermal Research (Netherlands);* **9**: No. 1, 1-27(Jan 1981).

As part of the resource evaluation and exploration program conducted by Los Alamos Scientific Laboratory for the national Hot Dry Rock (HDR) Geothermal Program, a regional magnetotelluric (MT) survey of New Mexico and Arizona is being performed. The MT lines are being located in areas where the results of analysis of residual gravity anomaly maps of Arizona and New Mexico, integrated with other geologic and geophysical studies indicate the greatest potential for HDR resources. The residual gravity anomalies are derived by applying the concept of predicting gravity anomalies from topography. This can be accomplished by employing reductions similar to those used in some isostatic investigations, in which a regional topographic surface is used as the Bouguer reduction datum. The datum is derived by comparison of various harmonics of Bouguer anomalies and elevations of stations. Topography can be used to predict Bouguer anomalies because of isostatic compensation; the resultant anomalies can be considered high frequency residual anomalies or isostatic anomalies corrected for regional compensation. Such maps have been produced for Arizona, New Mexico, west Texas, and Chihuahua, Mexico.

4715 **Seismic structure and seismicity of the cooling lava lake of Kilauea Iki, Hawaii.** Chouet, B.; Aki, K. (Massachusetts Inst. of Tech., Cambridge). Contract EY-76-S-02-2534. *NLJournal of Volcanology and Geothermal Research (Netherlands);* **9**: No. 1, 41-56(Jan 1981).

The use of multiple methods is indispensable for the determination of the seismic properties of a complex body such as a partially solidified lava lake. The combined results from various active and passive experiments conducted on Kilauea Iki in March 1976 suggest a rather thin (less than 10 m) zone of residual melt, the lateral extent of which is delineated by a sharp drop in the activity of seismic events occurring within the crust of the lake. The heavily fractured crust is characterized by P velocities ranging from 0.8 to 2.2 km/s and the P velocity could be even lower in the melt possibly because of the presence of gas bubbles. The present seismicity of the lake is compatible with the formation of tensile cracks caused by contraction due to cooling.

4716 **Oxygen and hydrogen isotope study of the Skaergaard intrusion and its country rocks: a description of a 55-M.Y. old fossil hydrothermal system.** Taylor, H.P. Jr. (California Inst. of Tech., Pasadena); Forester, R.W. *GBJournal of Petrology (England);* **20**: No. 3, 355-419(Aug 1979).

Oxygen isotope analyses have been obtained on rocks and coexisting minerals, principally plagioclase and clinopyroxene, from about 400 samples of the Skaergaard layered gabbro intrusion and its country rocks. The $\delta^{18}O$ values of plagioclase decrease upward in the intrusion, from normal values of about +6.0 to +6.4 in the Lower Zone and parts of the Middle Zone, to values as low as -2.4 in the Upper Border Group. The ^{18}O depletions of the plagioclase all took place under subsolidus conditions, and were produced by the Eocene meteoric-hydrothermal system established by this pluton. Clinopyroxene, which is more resistant to ^{18}O exchange than is plagioclase, also underwent depletion in ^{18}O, but to a lesser degree. The ^{18}O-depleted rocks typically show reversed $\Delta^{18}O$/sub plag-px/ fractionations, except at the top of the Upper Zone, where the pyroxenes are very fine-grained aggregates pseudomorphous after ferrowollastonite; these inverted pyroxenes were much more susceptible to subsolidus ^{18}O exchange. D/H analyses of the chloritized basalt country rocks and of the minor quantities of alteration minerals in the pluton (δ D = -116 to -149) confirm these interpretations, indicating that the rocks interacted with meteoric groundwaters.

4717 **Nature of the magma conduit under the east rift zone of Kilauea Volcano, Hawaii.** Furumoto, A.S. (Univ. of Hawaii, Honolulu). *ITBulletin Volcanologique (Italy);* **41**: No. 4, 435-453(1978).

From a combination of results of gravity, magnetic and seismic refraction surveys, the dike complex under the east rift zone of Kilauea Volcano in Hawaii was found to extend for 110 km from the summit area of the volcano to a point 60 km at sea beyond the eastern tip of the island. Near the summit the complex is 20 km wide, and at about 40 km distance from the summit, the complex narrows to 12 km wide. The main body of the dike complex is 2.3 km deep, but some parts are as shallow as 1 km. From extrapolation of temperature data of a deep well and from analysis of magnetic data, it was inferred that temperature of the dike complex is above the Curie point of 540°C. The internal part of the complex can approach the melting point of 1060°C. The dike complex is the source of thermal energy for a commercial quality geothermal reservoir that was found by drilling.

1506 Environmental Aspects And Waste Disposal

4718 **(DOE/ET/28502—1) Consultation for the H_2S and meteorological monitoring program of the Ente Nazionale per l'Energia Elecrtrica (ENEL). Final report.** Ruff, R.E.; Cavanagh, L.A.; Collis, R.T.H. (SRI International, Menlo Park, CA (USA)). May 1980. Contract AT03-76ET28502. 31p. NTIS, PC A03/MF A01.

Assistance in setting up a program for monitoring air quality in the vicinity of geothermal development in Larderello's vapor-dominated fields is reviewed. (MHR)

4719 **(PB—80-169246) Surface containment for geothermal brines. Final report.** Sung, R.; Murphy, W.; Reitzel, J.; Leventhal, L.; Goodwin, W. (TRW, Inc., Redondo Beach, CA (USA)). Feb 1980. Contract EPA-68-03-2560. 55p. NTIS, PC A04/MF A01.

This report examines the probability of significant releases of geothermal brine to the surface environment through unplanned or accidental events. It then evaluates the containment measures that may be used to prevent environmental damage. The results indicate that major spills are likely to be very rare and that simple warning systems and diked containment areas should provide adequate protection.

1507 By-products

REFER ALSO TO CITATION(S) 4530

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 4954

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 4712

4720 **(BNL—51249) New high temperature cementing materials for geothermal wells: stability and properties. Final report.** Roy, D.M.; White, E.L.; Langton, C.A.; Grutzeck, M.W. (Pennsylvania State Univ., University Park (USA). Physiology Labs.). Jul 1980. Contract AC02-76CH00016. 85p. NTIS, PC A05/MF A01.

Potential high-temperature cements have been formulated and evaluated in terms of their properties for geothermal well cementing. Phase formation and compatibility in two major compositional regions were investigated in the temperature region between 200 and 400°C and pressures up to 69 MPa (10,000 psi). These were followed by an evaluation of properties of the cements formed. One area in the system CaO-MgO-SiO_2-H_2O centered around the xonotlite-chrysotile join while the other area of interest centered around the anorthite composition in the system CaO-Al_2O_3-SiO_2-H_2O. After numerous exploratory studies, the magnesia-containing mixtures were prepared by mixing a Class J cement with various sources of magnesia such as calcined chrysotile, or magnesium oxide. Calcium oxide and silica fine quartz powder were also added to adjust the compositions. The aluminous system cements were formulated from high-alumina cements which were mixed with various silica sources.

4721 **(DOE/ET/27225—11) Geothermal two-phase flow: a selective, annotated guide to the literature. Report No. GEOFLO/7.** Bilicki, Z.; DiPippo, R.; Michaelides, E.E.; Kestin, J.; Maeder, P.F. (Brown Univ., Providence, RI (USA). Div. of Engineering). Jun 1980. Contract AC02-79ET27225. 32p. NTIS, PC A03/MF A01.

This bibliography includes only those references considered useful for the solution of problems facing a geothermal plant designer. Historical developments and flow models are discussed. (MHR)

4722 **(DOE/RA/12183—01) Geothermal materials program: strategy. Final report.** Crane, C.H.; Kenkeremath, D.C. (Engineering and Economics Research, Inc., Falls Church, VA (USA)). Oct 1980. Contract AC07-80ID12183. 102p. NTIS, PC A06/MF A01.

The following topics are discussed: program goal and objectives, program organization, and program status. Current program projects are described. (MHR)

4723 **(LA-UR—80-2991) DOE hot dry rock program.** Nunz, G.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01.

Hydraulic fracturing has been used to create and subsequently to enlarge the first hot dry rock heat-extraction loop at Fenton Hill, New Mexico. Encouraging results prompted the DOE to expand this project into a program of national scope. The elements of that Program and their present status are discussed. Emphasis is given the ongoing Fenton Hill Project where techniques and information developed in the existing research system will soon be used to produce a multiply-fractured engineering system in hotter rock at the same site. Recent results from research loop operation and progress in constructing the engineering system are reported. Although acoustic mapping and system geometry indicate that the primary hydraulic fractures are essentially vertical, relatively low fracturing pressure and absence of a sharp breakdown suggest that at Fenton Hill fracture initiation occurs by reopening of old natural fractures rather than by initiation of new ones. Flow patterns and temperature behavior suggest opening of additional old fractures as the loop is operated. Except where the hot fluid leaves the crack system to enter the production well, flow impedances are very low without either artificial propping or inflation by pressurization.

4724 **(LBL—11215) TFTR neutral beam source cryogenics.** Byrns, R. (Zais (Elliot) and Associates, Inc., Corvallis, OR (USA); Oregon State Univ., Corvallis (USA). School of Oceanography). Sep 1980. Contract W-7405-ENG-48. 80p. (GREMP—10). NTIS, PC A05/MF A01.

Data and analysis methods were gathered from the petroleum, geothermal, and hydrological literature. The data sets examined include: Wairakei, New Zealand -141 wells; Cerro Prieto, Mexico - 18 wells; The Geysers, USA - 27 wells; Larderello, Italy - 9 wells and groups; Matsukawa and Otake, Japan - 8 wells; and Olkaria, Kenya - 1 well. The analysis methods tested were; Arps's equations, Fetkovich type curves, Slider's method for Arps, Gentry's method for Arps, Gentry's and McCray's method, other type curves, P/z vs. Q method, Coats' influence function method, and Bodvarsson's Linearized Free Surface Green's Function method. The conclusions are: (1) The exponential equation fit is satisfactory for geothermal data. (2) The hyperbolic equation should be used only if the data fit well on a hyperbolic type curve. (3) The type curve methods are useful if the data are not too scattered. They work well for vapor dominated systems and poorly for liquid dominated systems. (4) Coats' influence function method can be used even with very scattered data. (5) Bodvarsson's method is still experimental but it shows much promise as a useful tool.

4725 **(PNL—3593) Detailed conceptual design of a high temperature glass pH electrode for geothermal applications. Final report. Task II.** Taylor, R.M.; Phelan, D.M. (Leeds and Northrup Co., North Wales, PA (USA)). Sep 1980. Contract AC06-76RL01830. 43p. NTIS, PC A03/MF A01.

The performance of a pH sensor for use in hot geothermal brine was determined by laboratory tests simulating the expected conditions of use. Tests were conducted at temperatures from 21°C to 260°C and pressures from atmospheric to 5000 psi. Probes were constructed according to the design recommended. Deficiencies were found in the areas of seal, stem glass integrity and glass stability in hot simulated brine. Modifications of the design were made and tested, the improved versions overcoming the seal and stem glass cracking problems. A different pH glass formulation was used which improved sensor performance. Test results of the final design show that the sensor survived hot brine exposure at temperatures up to and including 200°C, retaining its low temperature pH measuring capability. Exposure to 250°C brine resulted in irreversible probe changes which caused sensor deterioration and failure. Comparative results are shown.

4726 **Analysis of errors in using the two electrode and three electrode polarization resistance methods in measuring corrosion rates.** Danielson, M.J. (Battelle, Pac Northwest Lab, Richland, Wash). *USCorrosion (U.S.);* **36**: No. 4, 174-178(Apr 1980).

This theoretical paper outlines a simple method of reducing the error of the three electrode method when data is taken at /plus or minus/10 mV from the corrosion potential. Further, a general theoretical analysis of errors in using the two electrode method is presented. This work is an outgrowth from our studies into adapting commercial corrosion monitoring instruments to operate in geothermal environments. 8 refs.

4727 **Hot dry rock, an alternate geothermal energy resource--challenge for instrumentation.** Dennis, B.R.; Horton, E.H. (Los Alamos Sci Lab, NM). *USISA (Instrument Society of America) Transactions (U.S.);* **19**: No. 1, 49-58(1980).

The technique to demonstrate the technical and economic feasibility of extracting heat from the hot dry rock source depends upon the connection of two deep boreholes drilled into impermeable precambrian granite where the temperature approaches 200°C. The boreholes are connected by a system of hydraulic-produced fractures. Cold water flowing down the deeper hole will be heated by the hot rock and will be brought to the surface through the second hole. The hot water will be circulated through a closed-loop heat exchanger. The first phase of operating the 10 MW(t) heat extraction experiment will be conducted to determine the mechanical, physical, and chemical properties of the reservoir and heat exchange system. Environmental effects will be carefully monitored. For optimum extraction of energy from this man-made geothermal reservoir, it is vital that the absolute location of the fractured system be well established. Fracture mapping techniques include an array of downhole instrumentation that must survive the hostile environment of the deep hot boreholes. 8 refs.

1510 Direct Energy Utilization

4728 **(DOE/ET/27046—T1) Direct heat applications semi-annual program review.** FitzGerald, B.C. (Klamath County YMCA, Klamath Falls, OR (USA)). 1980. Contract FG03-79ET27046. 6p. NTIS, PC A02/MF A01.

Portions of document are illegible.

The problems involved in retrofitting a geothermal heating system to the existing space, water, and swimming pool water system of the Klamath County YMCA are reviewed. (MHR)

4729 **(DOE/ET/28407—T1) Water information bulletin No. 30 geothermal investigations in Idaho.** Mitchell, J.C.; Johnson, L.L.; Anderson, J.E.;Spencer, S.G.; Sullivan, J.F. (Idaho Dept. of Water Resources, Boise (USA)). Jun 1980. Contract AS07-77ET28407. 469p. NTIS, PC A20/MF A01.

There are 899 thermal water occurrences known in Idaho, including 258 springs and 641 wells having temperatures ranging from 20 to 93°C. Fifty-one cities or towns in Idaho containing 30% of the state's population are within 5 km of known geothermal springs or wells. These include several of Idaho's major cities such as Lewiston, Caldwell, Nampa, Boise, Twin Falls, Pocatello, and Idaho Falls. Fourteen sites appear to have subsurface temperatures of 140°C or higher according to the several chemical geothermometers applied to thermal water discharges. These include Weiser, Big Creek, White Licks, Vulcan, Roystone, Bonneville, Crane Creek, Cove Creek, Indian Creek, and Deer Creek hot springs, and Raft River, Preston, and Magic Reservoir areas. These sites could be industrial sites, but several are in remote areas away from major transportation and, therefore, would probably be best utilized for electrical power generation using the binary cycle or Magma Max process. Present uses range from space heating to power generation. Six areas are known where commercial greenhouse operations are conducted for growing cut and potted flowers and vegetables. Space heating is substantial in only two places (Boise and Ketchum) although numerous individuals scattered throughout the state make use of thermal water for space heating and private swimming facilities. There are 22 operating resorts using thermal water and two commercial warm-water fish-rearing operations.

4730 **(DOE/ID/12018—6) Colorado geothermal commercialization program: community development of geothermal energy in Pagosa Springs, Colorado.** Coe, B.A. (Colorado Geological Survey, Denver (USA)). 1980. Contract FC07-79ID12018. 64p. NTIS, PC A04/MF A01.

A district heating system for the Pagosa Springs central business district is in the planning stage. A detailed analysis of the project is presented. It comprises area and site specific studies and describes in detail the recent, current, anticipated, and postulated geothermal development activities. (MHR)

1520 Geothermal Data And Theory

4731 **(SAND—80-7159) Strength and ductility of room-dry and water-saturated igneous rocks at low pressures and temperatures to partial melting. Final report.** Friedman, M.; Handin, J.; Higgs, N.G.; Lantz, J.R.; Bauer, S.J. (Texas A and M Univ., College Station (USA). Center for Tectonophysics). Nov 1980. Contract AC04-76DP00789. 93p. NTIS, PC A05/MF A01.

Rock types that are likely candidates for drilling were tested. Reported herein are the short-time ultimate strengths and ductilities determined at temperatures of 25° to 1050°C and a strain rate of $10^{-4}s^{-1}$ of (a) room-dry Mt. Hood Andesite, Cuerbio Basalt, and Charcoal (St. Cloud Gray) Granodiorite at confining pressures of 0, 50, and 100 MPa, (b) water-saturated specimens of the same three rocks at zero effective pressure (both pore and confining pressures of 50 MPa), and (c) room-dry Newberry Rhyolite Obsidian at 0 and 50 MPa. These strengths are then compared with the stresses developed at the wall of a borehole in an elastic medium at the appropriate temperatures and mean pressures to assess the problem of borehole stability. (MHR)

4732 **Electrical conductivity of a spinel lherzolite and a garnet peridotite to 1550°C: relevance to the effects of partial melting.** Manghnani, M.H.; Rai, C.S. (Univ. of Hawaii, Honolulu). Contract E(04-3)-1093. *ITBulletin Volcanologique (Italy);* **41**: No. 4, 328-332(1978).

Electrical conductivity σ of two ultramafic rocks (a spinel lherzolite and a garnet peridotite) has been investigated to melting temperature at 1 bar under known oxygen fugacity environment. The electrical conductivity of the two rocks is found to increase with degree of partial melting and ~ 15% melt fraction is necessary for the electrical conductivity to increase by ~ 1 order of magnitude. For a given melt fraction electrical conductivity of a spinel lherzolite is lower than that of a garnet peridotite and may be attributed to the differences in the composition of the melts formed.

17 WIND ENERGY

1701 Availability (climatology)

4733 (EMD—78-2227) Preliminary investigation of exceptionally strong winds in mountainous areas of New Mexico. Reynolds, R.D.; Barnett, K.M. (New Mexico State Univ., Las Cruces (USA). Physical Science Lab.). Oct 1980. 26p. New Mexico Energy and Minerals Dept., Santa Fe, NM.

The mean wind speed in four mountainous areas in New Mexico were sampled for one year using wind data accumulators. The sites studied were: (1) San Augustin Pass, 15 miles northeast of Las Cruces; (2) Sierra Grande, an isolated peak midway between Raton and Clayton; (3) Buck Mountain, 10 miles northeast of Sierra Blanca Peak near Ruidoso, and (4) Palomas Mesa, 20 miles west-southwest of Tucumcari.

4734 (NE—25173) Off-shore wind power plants. Hardell, R.; Olsson, C.; Ljung, L. (Liber-Foerlag, Stockholm (Sweden)). 1979. 192p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01.

Information is presented concerning the offshore wind power availability in the Baltic Sea; and economics, specifications, and environmental considerations for large offshore wind power plants.

4735 (PNL—3195-WERA-4) Wind energy resource atlas. Volume 4. The Northeast region. Pickering, K.E.; Vilardo, J.M.; Schakenbach, J.T.; Elliott, D.L.; Barchet, W.R.; George, R.L. (Geomet, Inc., Gaithersburg, MD (USA)). Sep 1980. Contract AC06-76RL01830. 230p. NTIS, PC A11/MF A01.

This atlas of the wind energy resource is composed of introductory and background information, a regional summary of the wind resource, and assessments of the wind resource in each state of the region. Background is presented on how the wind resource is assessed and on how the results of the assessment should be interpreted. A description of the wind resource on a regional scale is then given. The results of the wind energy assessments for each state are assembled in this chapter into an overview and summary of the various features of the regional wind energy resource. An introduction and outline are provided for in the descriptions of the wind resource given for each state. Assessments for individual states are presented. The state wind energy resources are described in greater detail than is the regional wind energy resource, and features of selected stations are discussed. This preface outlines the use and interpretation of the information found in the state chapters.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 4733, 4734

4736 (DOE/RL/01830—T1) Candidate wind turbine generator site, Culebra, Puerto Rico. Annual data summary, January-December 1979. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 13p. NTIS, PC A02/MF A01.

This report summarizes wind speed and direction data collected on meteorological towers at 14 candidate and wind turbine generator installation sites from January 1979 through December 1979. The basic method of data collection is by digital data cassette recording systems. For the digital data reported, an instantaneous sample is recorded every 2 minutes. An explanation is included for each data summary table as well as information on how specific values were computed. The rest of the report presents the annual summarized data for each site.

4737 (DOE/RL/01830—T2) Candidate wind turbine generator site, Culebra, Puerto Rico. Annual data summary, October 1978-September 1979. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC06-76RL01830. 12p. NTIS, PC A02/MF A01.

This report summarizes wind speed and direction data collected on meteorological towers at 14 candidate and wind turbine generator installation sites from October 1978 through September 1979. The basic method of data collection is by digital data cassette recording systems. For the digital data reported, an instantaneous sample is recorded every 2 minutes. An explanation is provided for each data summary table as well as information on how specific values were computed. The rest of the report presents the annual summarized data for each site.

4738 (PB—80-169899) Technical feasibility study of a wind energy conversion system based on the tracked vehicle-airfoil concept. Annual progress report, 1 Sep-31 Dec 73. Powe, R.E.; Townes, H.W.; Blackketter, D.O.; Bishop, E.H. (Montana State Univ., Bozeman (USA). Dept. of Mechanical Engineering). 31 Jan 1974. 93p. NTIS, PC A05/MF A01.

Initial stages of a detailed technical feasibility study of a wind energy conversion system based on the tracked vehicle-airfoil concept are described. It is anticipated that the system will consist of airfoils mounted vertically on carriages which will move around a horizontal, closed track system. The orientation of the airfoils, relative to the winds will be automatically controlled to enable a maximum power extraction from the wind. During this first stage of the study, the performance specifications for the major system components required for converting wind energy to mechanical energy have been established, and the interface requirements between these components have been identified. Several possible alternatives for meeting these components and interface criteria have been selected, and a detailed study of a number of these alternatives is reported.

4739 (PB—80-170962) Technical feasibility study of a wind energy conversion system based on the tracked vehicle-airfoil concept. Progress report (final), 1 Sep 73-31 Aug 74. Powe, R.E.; Townes, H.W. (Montana State Univ., Bozeman (USA). Dept. of Mechanical Engineering). 30 Sep 1974. 85p. NTIS, PC A05/MF A01.

The technical feasibility of a unique momentum interchange device for extraction of energy from the wind is studied. It is shown that the maximum possible energy extraction with this tracked vehicle-airfoil device is greater than that for a conventional windmill. A comprehensive mathematical model is developed for the device and this model is programmed for solution on a digital computer. The program is written so that wind spectrum data for any geographic location can be used to determine monthly energy output for that location. Indications are that this device could make significant contributions to electrical power requirements. For example, a system 8 km long and consisting of airfoils 12 meters in length with a 3 meter chord could supply the electrical energy needs of about 17,000 people. Results are presented in a form which indicates the effect of changing various design parameters. In addition, comparisons of the energy output of the tracked vehicle-airfoil system with typical windmills are made. It is found that the monthly energy output per unit of swept area for the tracked vehicle-airfoil system may be as much as 54 percent greater than that for an efficient windmill operating in the same location.

4740 Unsteady potential aerodynamics of rotors with applications to horizontal-axis windmills. Preuss, R.D.; Suciu, E.O.; Marino, L. (Boston Univ, Mass). *USAIAA (American Insitute of Aeronautics and Astronautics) Journal (Combining the ARS Journal and the Journal of Aerospace Science) (U.S.);* **18**: No. 4, 385-393(Apr 1980).

The problem of a horizontal-axis windmill in incompressible, potential flow is considered. The problem is formulated in a frame of reference rigidly connected with the rotor. Two different integral equations (for finite-thickness and zero-thickness blades) are presented. The finite-thickness integral equation relates the values of the potential on the surface of the windmill to the values of the normal derivative, which are known from the boundary conditions. The wake is treated as a doublet layer of prescribed helicoidal geometry. In order to solve the integral equation, the windmill surface is divided into small quadrilateral surface elements. Each element is approximated by a portion of a hyperboloidal paraboloid passing through the corners of the actual surface element. The values of the potential and its normal derivative within each element are assumed to be constant and equal to the values at the cen-

troid of the element. This yields a set of linear algebraic equations in the unknown values of the potential. The zero-thickness integral equation is treated in a similar way. Numerical results for potential and power coefficient for finite-thickness and zero-thickness horizontal-axis windmills in steady and unsteady incompressible, potential flows are presented. Comparison with experiment is presented for helicopter rotors in hover. 20 refs.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

4741 (CONF-801079—, pp V.27-V.37) **Materials and process development for the water-cooled gas turbine high temperature turbine technology program.** Schilling, W.F. (General Electric Co., Schenectady, NY). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The materials and process technology efforts associated with the current HTTT program have as their goals the resolution of key materials and processes barrier problems associated with the fabrication of reliable water-cooled gas turbine hardware, which will experience 1425°C gas temperatures while maintaining metal surface temperatures below 538°C. In addition, actual turbine hardware (stage 1 and 2 nozzles) will be fabricated and tested in the current phase of the program. A composite design has been selected for the first stage hardware consisting of a load carrying spar surrounded by and bonded to a layer of high thermal conductivity copper alloy into which is bonded water-carrying tubes. The entire hot gas path portion of the nozzle and bucket are then clad with a corrosion-resistant skin. The copper inner layer distributes the high heat fluxes to the water-carrying tubes wile minimizing thermal gradients within the component. The second and third turbine stages will be of a more conventional monolithic design with appropriate water cooling passages. The lower heat fluxes and external heat transer coefficients associated with the latter stages permit the use of monolithic structures without affecting part design life.

4742 (CONF-801079—, pp V.38-V.41) **Potential use of modified 9 Cr-1 Mo steel for fossil utility boiler applications.** Sikka, V.K. (Oak Ridge National Lab., TN). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

A modified 9 Cr-1 Mo alloy under developent at ORNL in conjunction with Combustion Engineering is extremely useful as material for heat exchangers, superheater tubing, transfer lines, and reheater tubing. The usefulness of modified 9 Cr-1 Mo comes from its high tensile and creep strength, low ductile-brittle transition temperature, high upper shelf energy, excellent hardenability, good thermophysical properties, and significantly better stress corrosion resistance compared with currently used stainless steels. The use of this alloy will help eliminate the need for transition joints, a frequent failure problem in conventional power plants.

4743 (CONF-801079—, pp V.42-V.47) **Erosion-corrosion of alloys at high particle velocities.** Barkalow, R.H. (Pratt & Whitney Aircraft, Middletown, CT). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The overall objective of this program is to characterize and understand the behavior or gas turbine materials exposed to simultaneously occurring processes of oxidation or hot corrosion and high velocity solid particle impact. The experimental approach involves burner rig testing at specimen temperatures and gas velocities in the range of approximately 500 to 870°C and 200 to 300 m/sec respectively. The test environment is produced by ingestion of various types and amounts of liquid salt and solid particles (e.g. alumina, magnesia, and PFBC dust), both individually to isolate the effect of each and simultaneously to determine the natrue and severity of erosion-oxidation and erosion-hot corrosion interactions.

4744 (CONF-801079—, pp V.48-V.49) **Evaluation of hot corrosion resistance of candidate ceramic coatings for industrial/utility gas turbines.** Barkalow, R.H. (Pratt & Whitney Aircraft, Middletown, CT). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of this program is to evaluate and compare the hot corrosion resistance of various ceramics, including state-of-the-art plasma sprayed yttria-stabilized zirconia (YSZ) and advanced candidate ceramic coating materials, as a function of temperature and corrosive environment. Materials so far evaluated include plasma sprayed YSZ of varying yttria content, and plasma sprayed or bulk samples of silica, silicon nitride, zirconium silicate, alumina, mullite, and calcium silicate. Tests were performed in a tube furnace to permit accurate control of material temperature, type and amount of salt, and SO_3 pressure of the gaseous environment. Variables covered the range of temperatures at which significant hot corrosion of metallic coatings is known to occur (700 to 1000°C), pure Na_2SO_4 versus Na_2SO_4 with metallic sulfates, and SO_3 pressures in the general range anticipated for current and future fuel usage in utility gas turbines.

4745 (CONF-801079—, pp V.55-V.64) **Erosion study in turbomachinery affected by coal and ash particles.** Tabakoff, W.; Hamed, A. (Univ. of Cincinnati, OH). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Two cold gas particle erosion test facilities have been built at the University of Cincinnati's Propulsion Laboratory. The first was designed to obtain basic erosion data, particle impact, and rebound characteristics for particulate flow over a stationary specimen. Another test facility was then designed to simulate and measure the erosion of stationary and rotating turbomachine blades. In many turbomachinery applications, erosion takes place at elevated temperatures near the strength limiting temperatures of the materials used. In such cases the erosion characteristics can significantly change under the elevated temperatures. An erosion test facility was designed to provide erosion and rebound data in the range of operating temperatures experienced in compressors and turbines. For that purpose, this facility has been designated to operate at a test section temperature in the range of ambient to 1093°C (2000°F). In addition to high temperatures, the facility properly simulates all erosion parameters which were found to be important from previous testing at ambient temperatures. These parameters include particle velocity, angle of impact, particle size, particle concentration and sample size. A detailed description of these test facilities may be found in references given. Results are presented graphically.

4746 (CONF-801079—, pp V.67-V.68) **Plasma-deposited thermal barrier coatings.** Tucker, R.C. Jr.; Price, M.O.; Taylor, T.A. (Union Carbide Corp., Indianapolis, IN). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The purpose of this program is to determine the effects of variations in deposition parameters on the thermomechanical integrity of plasma deposited thermal barrier coatings of the type intended for use on utility gas turbine airfoils. This work has been divided into two phases. Phase I consisted of a general screening of twenty-two coating variations, and Phase II will involve a more thorough evaluation of six to eight coating variations, chosen on the basis of the results of Phase I. This report describes the work done in Phase I and indicates the direction Phase II will take. All of the thermal barrier systems tested in Phase I were of the two-layer (duplex) type with an oxide outer layer and an MCrA1Y undercoat(1). Two oxides were included: $MgO.ZrO_2$, because of its commercially demonstrated thermal shock resistance, and ZrO_2.20 wt/o Y_2O_3, because of its corrosion resistance and phase stability. The effect of oxide density was a major variable in this program. All coatings were applied to 4" long x 3/4" outside diamter x 0.090" wall thickness tubes of Hastelloy C-276. These tubes were tested four at a time in a thermal fatigue rig in which the sample face was alternately heated to 2300°F with an oxygen-methane burner then cooled to 500°F with a dry air blast.

4747 (CONF-801079—, pp V.71-V.72) **Protective coatings for claddings for turbines for use with pressurized fluidized-bed combustors (PFBC).** McCarron, R.L. (General Electric Co., Schenectady, NY). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

An erosion-corrosion simulator has been constructed which is capable of reproducing the significant aspects of an actual PFBC environment. The simulator capabilities include the ability to inject both particulate and corrosion contaminant species into a high temperature, high velocity gas stream to allow evaluation of erosion, corrosion and deposition on airfoil shaped specimens. Erosion tests at 1600°F utilizing PFBC particulate from the Exxon PFBC facility third cyclone catch have been successfully completed. These tests were conducted at gas and particle velocities of 800 ft/sec with particle loadings of 900 ppM (0.48 gr/scf) and 90 ppM (0.048 gr/scf) for 50 and 200 hours, respectively. Erosion, corrosion and deposition effects produced in the simulator are generally similar to erosion, corrosion and deposition observed during actual PFBC testing for comparable test conditions. The Exxon PFBC particulate contains sufficient alkali to produce a significant corrosion effect on gas turbine materials. Erosion, characterized by leading edge metal loss, was greater for the 50 hour test at the high particulate loading (900 ppM, 0.48 gr/scf) than for the 200 hour test at the lower particulate loading (90 ppM, 0.048 gr/scf). To date 1000 hours of testing have been completed.

4748 (CONF-801079—, pp V.73-V.78) **Protective coatings for utility gas turbines.** Goebel, J.; Bornstein, M.; Krasij, M. 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The reliability and durability of gas turbines used in electric utility service to date have been compromised by hot corrosion of the first stage turbine airfoils. This situation persists in utility turbine engines which currently are operated with distillate fuels. However, should the utilization of lower quality residual and coal derived fuels become common, the hot corrosion problem could become extremely severe. Unless new corrosion resistant coatings and application techniques are developed, the amount of down time and required corrective maintenance will increase. The objective of this program is to develop coatings for utility gas turbines which will improve the durability of the present generation of industrial gas turbines, thereby increasing on-line availability and subsequently reducing maintenance costs. In addition, it is hoped that the planned program will develop methodologies and techniques which will improve the efficiency and durability of next generation industrial gas turbines by allowing the turbine hot section airfoils to achieve longer lifetimes while utilizing fuels with higher contamination level and/or while operating at higher temperatures.

4749 (CONF-801079—, pp V.79-V.88) **Advanced technology high temperature CrMoV steam turbine rotors.** Steiner, J.E. (Engineering Materials & Processes, Inc., Pittsburgh, PA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The EPRI project, RP 1343, was initiated in 1978 to demonstrate advanced methods for producing high temperature CrMoV steam turbine rotors in comparison with conventional rotors and to install such rotors in operating plants. Processes considered were electroslag remeltin (ESR), central zone remelting (MHKW or CZR), electroslag hot topping (ESHT), low sulfur (low S), and low sulfur vacuum carbon deoxidation (VCD). From these candidates three were selected, low S, VCD, and ESR. The rationale for selection was complex, but one technical objective was to determine as directly as possible the quantitative differences between pure ESR and advanced conventional processing. If differences were proved to be small, ESHT, CZR, and other related processes, which contain varying amounts of electroslag remelted steel would be expected to fall between and thus could be judged mainly on their economic merits. Quality criteria for comparative evaluations include ingot homogeneity and soundness, mechanical properties, toughness, elevated temperature properties, and rotor acceptance testing. Comparisons are being made among the advanced technology rotors and a sample of 29 recent production rotors. Results confirm expectations that even a large ESR ingot exhibits excellent homogeneity, soundness, and general quality. However, with the exception of some chemical segregation, A segregate streaks, and non-metallic inclusions, the low sulfur conventional and low sulfur VCD rotors may be close competitors.

4750 (CONF-801079—, pp IV.33-IV.37) **Technology for ceramic tube heat exchangers.** Ward, M.E. (Solar Turbines International, San Diego, CA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Present gas turbines must operate with high grade fuels to avoid damage when the combustion gases are expanded through the turbine. Low grade fuels including coal can be used if the turbine is fired indirectly by the transfer of heat from the combustion gases to the compressor air by means of a heat exchanger. The new, silicon-base ceramics appear to be the only materials able to provide the strength at temperature, erosion and corrosion resistance, and thermal shock resistance required in the tubes of this heat exchanger. The program encompassed material strength screening tests, coal environment materials interaction tests, joining technology, heat exchanger module design, and construction. The objectives of the program were to develop and identify technology enabling the construction of a full size pressurized, high temperature ceramic heat exchanger module. The successful operation of the full size ceramic heat exchanger above 1150°C (2100°F) outlet temperatures at 689 kPa (100 psi) with firing temperatures at 1370°C (2500°F) must be considered the major achievement of this project. While not excluding other technology advancements that were made during this project, the successful operation of the full size test module demonstrates that operation of a ceramic shell and tube heat exchanger at high temperatures with large pressure differentials is mechanically and thermally feasible.

4751 **(EPRI-AP—1599(Vol.2)) High-reliability gas turbine combined-cycle development program: Phase I. Volume 2. Appendixes. Interim report, October 1980.** Boenig, F.H.; Lewis, J.H. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1980. 131p. NTIS, PC A07/MF A01.

Results are presented of Phase I of a multi-phase program leading to the development of a High Reliability Gas Turbine. The engine would be used for the base load, combined-cycle application starting in the mid-1980's. The design, with primary emphasis on reliability, recognizes the need on the part of the electric utility user for high operating availability together with low maintenance cost to take full advantage of the capital cost and efficiency advantage offered by the combined cycle plant. Phase I was a conceptual design study of both the gas turbine itself and the full plant. Reliability for all component equipment was emphasized from the very outset. In the case of the gas turbine, high reliability was reflected in a concept that features ruggedness and simplicity. Ease of maintenance was provided through structural simplicity and modularization. Component designs for the gas turbine were selected on the basis of a review of past operational experience and an in-depth statistical reliability analysis. Design details were then determined using trade-off and parametric studies. Reliability in the auxiliary and balance of plant waste heat recovery equipment was provided by redundancy of critical components as well as the use of proven equipment. Careful attention was paid to developing a concept for a highly reliable control system that blends automatic operation with manual override for operator intervention. A condition monitoring system to provide alerts for incipient shut down conditions was also incorporated into the control design concept. The final gas turbine design is a 107 MW, single-shaft engine. Projected availability for the final engine installed in a combined-cycle plant is 92%. This design will serve as a firm point of departure for the preliminary design to follow during the Phase II program.

4752 **(EPRI-CS—1578-SR) Materials for generator retaining rings: a state-of-the-art review.** Viswanathan, R. (Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1980. 42p. NTIS, PC A03/MF A01.

Retaining rings are among the highest stressed components of electrical generators, whose integrity is critical to the reliable and safe operation of the generators. Numerous instances of cracking of the rings, culminating in some cases in a catastrophic burst of the ring and extensive damage to the generator have been noted. A major cause of the failures is known to be the susceptibility of the currently used 18 Mn-5 Cr steel to environmentally induced cracking. Data available in the literature indicates that the currently used alloys are quite susceptible to stress corrosion cracking in a variety

of environments and that they have reached their limit not only in terms of fracture toughness in adverse environments but also in terms of achievable yield strength levels. The availability of newer materials and/or design concepts may become a limiting factor in the reliability of current machines as well as in the ability to build larger machines requiring larger diameter retaining rings in the future. The present method of fabricating the retaining rings by cold expansion requires special equipment and expertise available only with a few foreign manufacturers and hence has an adverse impact on the price as well as the procurement schedule for the rings. This paper presents a broad overview of the principal materials considerations involved and of the data available on currently used materials. Recent developments aimed at the use of alternate materials will be described.

4753 **(EPRI-CS—1594) User's manual for WDCSIM II wet/dry cooling computer program. Final report, October 1980.** Guyer, E.C.; Brownell, D.L. (Dynatech R/D Co., Cambridge, MA (USA)). Aug 1980. 113p. NTIS, PC A06/MF A01.

A user's guide to the WDCSIM II computer program has been compiled. Instructions are provided for the application of the computer program to the modeling of the thermal performance and economics of combined wet- and dry-cooling systems for large steam-electric plants. A FORTRAN listing of the program is presented along with a sample output.

4754 **(EPRI-CS—1604) Detection of water induction in steam turbines. Final report.** Benedict, R.P.; Wonn, J.W.; Luongo, M.C.; Wyler, J.S. (Westinghouse Electric Corp., Philadelphia, PA (USA)). Nov 1980. 58p. NTIS, PC A04/MF A01.

The objectives of this report were to compare several ultrasonic sensing systems with thermocouple and pressure systems for their response to the presence of water in steam pipes. Water was purposely introduced into pipes in laboratory controlled situations which included static backup and the two-phase regimes of film, slug, particle, and chunk flows. All data were preserved on magnetic tape for subsequent analysis. All sensing methods were found to be responsive to all types of steam/water induction, with the ultrasonic instrumentation believed to show advantages because of its rapid respone and its nonintrusive nature.

4755 **(EUR—6794DE) Comparison of the working plant conditions for conventional and nuclear steam power plants in the community.** Plate, K.; Nitsch, D.; Schmitz, H.; Teichel, H. (Commission of the European Communities, Luxembourg). 1980. 106p. (In German). NTIS (US Sales Only), PC A06/MF A01.

Information is presented on methods for determining availability values for conventional and nuclear power plants; comparison of work availability and 8 o'clock availability; the availability of conventional and nuclear power plants in West Germany and in the European Communities (EC); principal causes of non-availability for EC nuclear power plants; and a listing of nuclear power plants in the EC. (LCL)

4756 **(FE—1806-96) Development of high-temperature turbine subsystem technology to a technology readiness status, Phase II. Quarterly report, July-September 1980.** Horner, M.W. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Oct 1980. Contract AC01-76ET10340. 86p. NTIS, PC A05/MF A01.

The objective of the DOE-HTTT (High-Temperature Turbine Technology) Program is to bring to Technology Readiness, over a six- to ten-year duration, a high-temperature gas turbine for use in a combined-cycle power plant, with coal-derived fuel, at a firing temperature of 2600°F and with growth capability to 3000°F. The three phases of the program encompass the design, development, manufacture, and test of a GE-TRV gas turbine system at a DOE facility. Phase I was completed, and Phase II commenced on August 1, 1977. The objectives of Phase II are to: (1) perform component design and technology testing in critical areas; (2) perform system design and trade-off analyses in sufficient depth to support the component design and test tasks; and (3) update the Phase I combined-cycle plant studies to evaluate the commercial viability of a GE-TRV gas turbine system.

4757 **(FE—2357-39(Vol.A)) PFB coal fired combined cycle development program. Advanced hot gas cleanup concept evaluation (Task 4.3). Volume A. Aerodyne cyclone evaluation.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Nov 1980. Contract AC21-76ET10377. 91p. NTIS, PC A05/MF A01.

This report summarizes the results of testing of a rotary flow cyclone, manufactured by Aerodyne Development Corporation under license by Siemens Kraftwerk Union. This cyclone was selected for evaluation due to the unusually high separative efficiencies claimed by the manufacturer (based on developer data), and relative lack of open literature data. The most significant finding of this work was the observation that electrostatic forces could enhance or, in fact, dominate the separation process. Separative efficiencies, with electrostatic forces present, were found to be substantially independent of flow rate and, by inference, could be independent of unit size. This finding suggests that large cyclones with natural or augmented electrostatic forces employed in the hot gas cleanup train of the CFCC system may not suffer the performance degradation compared to small cyclones, as projected from conventional inertial theory. This is of special importance since the use of many small cyclones in parallel, or multicyclones, commonly suffers from fouling and this approach is not recommended in the CFCC application. The original objective of this investigation was to assess the relative merits of the Aerodyne cyclone separator. It was found from both the cold flow and the hot flow tests that its separative efficiencies are disappointingly poorer than expectations (in agreement with Westinghouse results), and even poorer than conventional cyclones.

4758 **(FE—2357-67) PFB coal fired combined cycle development program. Gas turbine materials evaluation report.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Sep 1980. Contract AC21-76ET10377. 125p. NTIS, PC A06/MF A01.

Several significant conclusions can be made: Cooling of PFB powered gas turbine components to 1350 to 1475°F appears to offer a viable method for extending the life of components. The reduction of particulate efflux via cyclones is sufficient to eliminate excessive erosion in the stationary cascades tested. Coatings and claddings of the M(Co,Fe) CrAlY class offer substantial increases in lifetimes over conventional bare alloys in the PFB derived environment. Protective systems will be required to provide adequate life for PFB-powered gas turbines operating at temperatures equal to or higher than 1550°F. Deposition does not appear to be a serious limitation to the utilization of PFB-powered gas turbines. There is apparently a critical particle size below which no erosion will occur. The results at CURL suggest this critical size is 10 μm or smaller for the size of airfoils and the obtained velocities. The MS-1002 first stage bucket design is amenable to conventional cladding techniques. The 1600°F burner rig test produces a close approximation of the relative ranking of materials exposed in actual PFB exhaust. The 1400°F small burner rig test is not representative of 1400°F PFB exhaust exposure in either relative ranking or type of attack. The compositional limitations of cladding alloys, which offer resistance to PFB environments, are significant for cobalt base systems as both chromium and aluminum contents strongly affect ductility. Low aluminum Fe and Co base cladding systems with 25% chromium appear to offer promise. These systems should be compared against the more promising coatings, M(Co,Fe)CrAlY and pack aluminide plus platinum, in actual high temperature PFB applications with low dust loadings and small particle sizes.

4759 **(FE—2357-74) Coal fired combined cycle development program. Quarterly report, April-June 1980.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 1980. Contract AC21-76ET10377. 10p. NTIS, PC A02/MF A01.

In July 1978, the CFCC program was extended. The prime thrust of the follow-on effort is to extend the results obtained in the Gas Turbine Materials and the Hot Gas Cleanup Technological areas of investigation. Work to date has identified the need to protect the gas turbine from corrosion caused by substantial amounts of alkali in the submicron aerosol and vapor phase and to protect the turbine from erosion caused by multi-micron-sized particulates. A potential solution to the corrosion protection challenge can more

confidently and quickly be found by extending turbine materials work in dirty liquid fuels to the PFB environmental levels. Particulate removal for erosion protection has as its objective a better quantification of the erosion tolerance level coupled with work to improve the performance of inertial separators, including electrostatic augmentation, in the less-than-10 m-particle-size regions. Plans are given briefly.

4760 (PB—80-170525) Recommended guidelines for safety inspection of construction of concrete cooling towers. Lew, H.S.; Fattal, S.G.; Hunt, B.J. (National Engineering Lab. (NBS), Washington, DC (USA)). Feb 1980. 37p. NTIS, PC A03/MF A01.

The guidelines furnished are based on existing OSHA regulations, but highlight their application to this type of construction by pointing out critical construction operations, their safety aspects, and needed compliance inspection procedures. Major regulatory provisions affecting the basic construction plans, safety aspects of design criteria and responsibilities, recordkeeping, and inspections are summarized. Special attention is given to construction loadings, construction sequences, hoisting systems, and personnel safety training. Detailed identification is made of items relating to concrete inspection, concrete control, formwork operations, construction loadings, hoisting systems, and construction safety planning.

4761 High-temperature turbine for operation on coal-derived fuel. Mogul, J.M.; Wolf, J.C.; Bunker, W.W. (Curtiss-Wright Corp, Wood-Ridge, NJ). *USMechanical Engineering (U.S.);* **102**: No. 4, 51-57(Apr 1980).

A developmental program is under way for generating clean, high-efficiency electric power from coal by integrating a low-Btu coal gasification system with a combined gas turbine-steam turbine cycle. Achieving this objective is dependent on developing a gas turbine that can operate at temperatures over 2600°F (1430°C) in a combusted coal-gas environment. Transpiration-air-cooling of hot section blades and vanes is a concept that can effectively deal with both high gas temperatures and the aggressive atmosphere. The concept, early test experience, and the building block testing approach for evaluating transpiration-air-cooling on simulated coal-derived fuel are discussed. 2 refs.

4762 Drift drop deposition rate at a short distance from natural-draft cooling towers. Pena, J.A. (Pa State Univ, University Park). *GBAtmospheric Environment (England);* **14**: No. 4, 429-431(1980).

The drift deposition rate has been measured at short distances (170 and 250 m) from the cooling towers at the Keystone Power Plant (Indiana, PA). The measurements were made during high humidity conditions such that the drift drops could be assumed to have a constant fall velocity. These results are compared with the predictions by two theoretical formulas and it is found that the predicted values are much lower than the observed ones. 6 refs.

4763 (PB—80-168321) Evaluation of energy processes through entropy and energy. Final report. Voigt, H. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). [nd]. 27p. NTIS PC E03/MF E03.

The measure of effectiveness with which energy is transformed or used in processes requires consideration of properties other than energy alone. Entropy is the most important quantity in this context. It permits to localize sources of ineffectiveness and calculate thermodynamic upper limits of efficiencies. Energy is closely related to entropy and can be used for similar purposes; it also has the same dimension and order of magnitude as energy, but is not a variable of state in a thermodynamic sense. In this memorandum, the formalism is introduced and discussed for a coal-fired electric power plant, methanol production, and negentropy technologies. It is proposed to favor entropy production or energy consumption over the concept of wasted or consumed energy as a measure of the effectiveness of energy use or conversion.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 4481, 4483, 4484, 4485, 5124, 5255, 5278

4764 (BNL—51279) Value of forestation in absorbing carbon dioxide surrounding a coal fired power plant. Dang, V.D.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Aug 1980. Contract AC02-76CH00016. 25p. NTIS, PC A02/MF A01.

The dispersion of carbon dioxide emitted from 1000 MW(e) coal fired power plant is investigated. Calculated ground level carbon dioxide concentrations as a function of distance from the power plant stack is validated by the results derived from sulfur dioxide dispersion measurements. Forestation is examined as a means for removal and control of atmospheric carbon dioxide at a distance of 5 to 10 km away from the power plant stack. An equilibrium and a dynamic approach are considered. For an average temperate zone forest growth rate (7.42 mg/dm^2 h), the overall reduction in forested land area required to remove the equivalent of all of the CO_2 from a 1000 MW(e) power plant would be less than 3.3% compared to removing the equivalent amount of CO_2 by planting forests remotely from the plant. If faster growing tropical plants or trees having up to 4 times the temperate plant growth rate were used, there would be a maximum savings of 15% in forested land area compared to a remote planting. This magnitude of reduction in cultivated forest area is insufficient to recommend planting forested areas adjacent to central power stations as a means of controlling CO_2 emission. Rather it is suggested to provide sufficient increased regional forested areas on a global scale for the purposes of absorbing the equivalent increase in CO_2 emission due to increased fossil fuel use.

4765 (DOE/RA/29323—1) Psychoacoustic evaluation of transmission line audible noise: building attenuation effects, methodology comparison, and field study feasibility. January 1, 1979 to December 31, 1979, Volume 1. Molino, J.A.; Zerdy, G.A.;Tremaine, S.G. (National Engineering Lab. (NBS), Washington, DC (USA)). 1980. Contract AT01-77ET29323. 85p. NTIS, PC A05/MF A01.

Research on evaluating the effects of corona noise from EHV and UHV power transmission lines on humans inside buildings is described. The corona noise from transmission lines was recorded, reproduced for human listeners in a simulated living room and the human response to the noise was measured in the room. It was found that: despite its low sound level, corona noise is somewhat more adversive to people than might be expected on the basis of physical measurements of the sound; corona noise may not be a problem inside a well-constructed and insulated house with the windows closed; high frequency hissing and crackling noises are more aversive than low-frequency humming and buzzing noise components; and more data is needed to evaluate the human response to corona sounds. (LCL)

4766 (EPRI-FP—1006(Vol.1)) Electrostatic precipitator plate rapping and reliability. Volume 1. Finite element analysis and laboratory-scale testing of rapped precipitator plates. Final report. Billington, D.P.; Nagy, D.A.; Lee, P.C.Y.; Mark, R. (Princeton Univ., NJ (USA)). Sep 1980. 324p. NTIS, PC A14/MF A01.

The objective of this study was to develop a data base and analytical model which could, in the long term, lead to a design and optimization methodology for the design of collecting surfaces for use in electrostatic particulate precipitators. Response to varying in-plane rapping intensities was measured in the in- and out-of-plane directions. The dynamic response was obtained as a function of time, location, rapper and plate configuration. These data were obtained on full scale plates. In addition, laboratory scale experiments were conducted to determine the effect of dust on surface response. The data obtained show that the dynamic response of the collecting surface is extremely complex. The stress waves generated by rapping travel at sonic velocities. These waves cause both complex in-plane and out-of-plane accelerations. The in-plane accelerations reach a maximum prior to the out-of-plane accelerations. Dust will dampen the response. Based on these findings it is evident that additional work should be undertaken to evaluate the contribution

of each acceleration mode, and intensity, on dust removal and reentrainment.

4767 **(ORNL/TM—7263) Water law constraints to siting and operating coal-fired electric generation plants in Kentucky.** Rosemarin, C.S. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 78p. NTIS, PC A05/MF A01.

The purpose of this study was to reveal possible constraints in the applicable laws to increased siting and continued operation of coal-fired power plants in Kentucky. This study includes not only the law of water availability, but some aspects of water quality as well. Kentucky's system of water resource allocation was reviewed to determine whether energy facilities, particularly steam-electric power plants, will be able to depend on a legally sustainable right to water which is physically available, especially during periods of low flow. A primary link between water quantity and quality is then discussed. Water consumption by cooling towers may limit the availability of water for use by additional power plants, other energy conversion systems, and other water users generally. This matter is largely governed by implementation of the section of the Clean Water Act dealing with discharge of thermal effluent.

4768 **(PB—80-166853) Survey of dry SO_2 control systems. Final report, Apr 79-Jan 80.** Blythe, G.M.; Dickerman, J.C.; Kelly, M.E. (Radian Corp., Durham, NC (USA)). Feb 1980. Contract EPA-68-02-2608. 122p. NTIS, PC A06/MF A01.

The report gives results of an assessment of the status of dry flue gas desulfurization (FGD) processes in the U.S. for both industrial and utility applications. The assessment is based on reviews of past and current research, development, and commercial activities. Systems covered include: (1) spray dryers with either baghouse or electrostatic (ESP) particulate collectors, (2) dry injection of alkaline material followed by baghouse or ESP collection of wastes, and (3) other systems, such as coal-alkaline material feeds to a combustor and passage of flue gas through a fixed bed of alkaline material. A summary of dry FGD processes, including key features of three types of dry systems and commercial systems, is provided. Limited economic data are also presented. Conclusions and recommendations are given on the potential role EPA can take to advance the overall environmental acceptability of dry FGD systems as viable SO_2 control alternatives.

4769 **(PB—80-169790) Health hazard evaluation determination report 79-130-645, Craig Power Plant, Craig, Colorado.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1979. 7p. NTIS, PC A02/MF A01.

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) at the Craig Power Plant, Craig, Colorado, on September 26, 1979. Breathing zone air samples were taken for acetone, styrene, and 2-butanone (methyl ethyl ketone/MEK). Airborne concentrations of these contaminants were not detected by the sampling/analytical methods used; however, the odors characteristic of these were easily observed at the time of this survey. All workers were interviewed. The interviews were directed towards exposures to acetone, MEK, and styrene. At the time of this evaluation several of the workers, as well as NIOSH investigators, reported complaints such as narcosis burning eyes, and upper respiratory tract irritation. Based on employee interviews, a potential health hazard exists even though all air samples taken during this survey were below laboratory detection limits.

2003 Power Transmission And Distribution

4770 **(BPA-BIO—78-1) Electrical and biological effects of transmission lines: a review.** Lee, J.M. Jr.; Bracken, T.D.; Capon, A.S.; Sarkinen, S.H.; Ihle, G.M.; Perry, D.E.; Eyler, T.R. (Bonneville Power Administration, Portland, OR (USA)). Nov 1978. 78p. NTIS, PC A05/MF A01.

The electrical effects of power transmission lines and the effects that such lines may have on man and his environment are described. The electric effects include corona discharges, electric and magnetic field effects of ac lines, and induced currents and voltages from dc lines. Some of the methods used by BPA to reduce or eliminate undesirble biological effects are also discussed. The appendixes contain information on grounding criteria and research related to the biological effects of transmission lines. (LCL)

4771 **(DOE/ET/29305—T1) Survey of transmission line corridors.** (Commonwealth Associates, Inc., Jackson, MI (USA)). 5 Jan 1979. Contract AC05-78ET29305. 166p. NTIS, PC A08/MF A01.

The intent of this study is to determine the extent of delays experienced in planning and constructing transmission lines in the continental United States. The reasons for the delays are identified for each line studied and their effect on the total electrical system is sought. Data was collected for 136 different lines either recently built or currently under study. Statistics were developed for each line in several categories and comparisons of lines delayed were made by company, area served and generation capacity. From the study presented here it was found that: right-of-way acquisition procedures including condemnation and easement negotiation practices delay more projects than local, state and federal regulatory requirements combined; load growth reductions particularly in the east have reduced the impact of regulatory delays; the south, southeast and southwestern areas of the country experience fewer delays in constructing transmission lines than the more populated states, and the cost for corridor delays was responded to for only 17 of the 142 projects surveyed. By far the most costly delay is the expense of condemning land for transmission right-of-way.

4772 **(EPRI-EL—1569) Long-range transmission expansion models. Final report.** Limmer, H.D. (Ebasco Services, Inc., New York (USA)). Oct 1980. 145p. NTIS, PC A07/MF A01.

Long-Range Transmission Planning (LRTP) expansion models are computer programs used to simulate the expansion of a power transmission system for planning purposes. There are two general categories of models: heuristic models which determine the optimum expansion one step at a time, and mathematical optimization models which determine the best expansion pattern by the simultaneous solution of one large set of equations and constraints. The use of these models by utility system planners has been relatively limited although many types of models have been described in the technical literature and several models are commercially available. The purpose of this project was to define the requirements of a practical LRTP expansion model, and to recommend directions in which future research efforts might be appropriate. After a literature search was performed, a survey was made of utility planners in order to determine their views as to their needs and their attitudes toward various modeling methods and assumptions. This survey consisted of a mail survey using a questionnarie and some personal in-depth interviews. Based on the results of the survey, the characteristics that make a model practical for use by planners were examined; practicality in a model involves both effectiveness in use and credibility of the results. Finally, recommendations were made for directions of future research.

4773 **(EPRI-WS—79-184) Digital techniques for control and protection of transmission class substations.** Nilsson, S.L. (Electric Power Research Inst., Palo Alto, CA (USA). Transmission Dept.). Aug 1980. 275p. (CONF-7911127—). NTIS, PC A12/MF A01.

From Digital techniques for control and protection of transmission class substations; San Diego, CA, USA (15 Nov 1979).

A workshop, organized by the Electric Power Research Institute, was held November 15 and 16, 1979 for discussion of digital techniques for control and protection of transmission class substations. The workshop dealt with the system requirements; discussed conceptual designs of digital systems; the use of data links and data highways within the systems; discussed test and maintenance philosophies; and reviewed the state-of-the-art in supporting technologies, which are primarily the microprocessors and fiber-optic communication technologies. Initial results from EPRI's Substation Control and Protection project (RP 1359) were presented as a case for discussion. The main conclusions from the workshop were that the supporting technologies are not sufficiently advanced for the substation control and protection application. The major problem

facing the system designers is to find a system architecture that balances the security, reliability, and modularity requirements against the cost of the system. The general cost trends are, however, favorable for the microprocessor-based, modular control and protection system, which makes the choice less critical.

4774 **(PB—80-170251) Characterization of the electric environment under hvdc transmission lines: instrumentation and measurement. Final report.** Kotter, F.R. (National Bureau of Standards, Washington, DC (USA)). Aug 1979. 29p. Pub. in Proceedings of the Workshop on Electrical and Biological Effects Related to HVDC Transmission, Richland, WA, October 19-20, 1978, Paper PNL-3121, UC97a, p2.1-2.29 1979.

The instrumentation and measurement techniques used in atmospheric electricity research which have possible application for use in studying conditions in the vicinity of high-voltage direct-current transmission lines are reviewed. Thirty-four references are given.

4775 **(UCID—18848) Low pressure switch progress report.** Lauer, E.J.; Birx, D.L.; Masamitsu, J.A.; Melendez, R.E.; Smith, I.D.; Yu, S.S. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 17 Nov 1980. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01.

A low pressure switch is being testing with applied E-field approximately ten times larger than previously used. The switch is connected to a 5.4 ohm transmission line, and charge voltages up to 150 kV have been tried. Self-breakdown critical conditions have been measured and pd (Paschen) scaling is found to hold as predicted by a numerical model. The time dependent current is measured following triggering and the current initially increases exponentially with time with the rate constant varying linearly with gas pressure and increasing with increasing molecular mass. Good agreement is obtained with a one-dimensional time dependent numerical model for space charge limited electron flow enhanced by positive ions arising from gas ionization. For a Blumlein with a 49 ns idealized pulse length, the rate of rise of current is acceptable up to charge voltages of 50 or 100 kV and is inadequate for larger voltages. The time jitter is good and preliminary tests indicate that the voltage holding recovery time is short (100 μs). Modifications are suggested that may improve the performance.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 4755, 4926

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 4849, 4868

4776 **(ALO—131) Integrating reliability analysis and design.** Rasmuson, D.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1980. Contract AC07-76ID01570. 67p. (EGG-IS—5187). NTIS, PC A04/MF A01.

This report describes the Interactive Reliability Analysis Project and demonstrates the advantages of using computer-aided design systems (CADS) in reliability analysis. Common cause failure problems require presentations of systems, analysis of fault trees, and evaluation of solutions to these. Results have to be communicated between the reliability analyst and the system designer. Using a computer-aided design system saves time and money in the analysis of design. Computer-aided design systems lend themselves to cable routing, valve and switch lists, pipe routing, and other component studies. At EG and G Idaho, Inc., the Applicon CADS is being applied to the study of water reactor safety systems.

4777 **(CONF-801107—30) Existence of short and long range relaxation lengths in heterogeneous media.** Difilippo, F.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Experimental data related to boiling water reactors show that the phase of the cross power spectra density between the detector response at two points in the system is described by a pure delay process above certain values of the frequency. For this to occur the adjoint flux (detector field of view) must be sharply peaked around each one of the detectors, which in turn implies the existence of a short range relaxation length. It is shown that the existence of this type of relaxation length is a direct consequence of the physical properties of heterogeneous systems and not a consequence of the number of groups used to describe the neutron field in the equivalent homogeneous system as it has been done traditionally. To show this point a one-group neutron diffusion model which accounts explicitly for the heterogeneities of the system is presented.

4778 **(CONF-801107—35) SCALE system cross-section validation for criticality safety analysis.** Hathout, A.M.; Westfall, R.M.; Dodds, H.L. Jr. (Al-Azhar Univ., Cairo (Egypt); Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The purpose of this study is to test selected data from three cross-section libraries for use in the criticality safety analysis of UO_2 fuel rod lattices. The libraries, which are distributed with the SCALE system, are used to analyze potential criticality problems which could arise in the industrial fuel cycle for PWR and BWR reactors. Fuel lattice criticality problems could occur in pool storage, dry storage with accidental moderation, shearing and dissolution of irradiated elements, and in fuel transport and storage due to inadequate packing and shipping cask design. The data were tested by using the SCALE system to analyze 25 recently performed critical experiments.

4779 **(SAND—80-0692) Assessment of LWR piping design loading based on plant operating experience.** Svensson, P.O. (EDS Nuclear, Inc., San Francisco, CA (USA)). Aug 1980. Contract AC04-76DP00789. 249p. (ALO—90). NTIS, PC A11/MF A01.

The objective of this study has been to: (1) identify current Light Water Reactor (LWR) piping design load parameters, (2) identify significant actual LWR piping loads from plant operating experience, (3) perform a comparison of these two sets of data and determine the significance of any differences, and (4) make an evaluation of the load representation in current LWR piping design practice, in view of plant operating experience with respect to piping behavior and response to loading.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

4780 **(DOE/ET/34212—27) Qualification of the B and W Mark B fuel assembly for high burnup. Third semi-annual progress report, July-December 1979.** Coleman, T.A. (Babcock and Wilcox Co., Lynchburg, VA (USA)). Mar 1980. Contract AC02-78ET34212. 121p. NTIS, PC A06/MF A01.

Five Babcock and Wilcox-designed Mark B (15 x 15) pressurized water reactor fuel assemblies were irradiated to extended burnups in Duke Power Company's Oconee Unit 1 reactor. An assembly average burnup of 40,000 MWd/mtU, which is about 29% greater than previous discharge burnups at Oconee 1, was attained. The nondestructive examination of these five assemblies, which have been irradiated for four fuel cycles, was begun. Data obtained included fuel assembly and fuel dimensions, water channel spacings, fuel rod surface deposit samples, and holddown spring preload forces. Visual examination of the assemblies indicated that good fuel performance was maintained through four cycles of irradiation.

4781 **(SAND—80-6028) Investigation of crud deposition on pressurized water reactor fuel elements.** Neeb, K.H.; Riess, R. (Kraftwerk Union A.G., Erlangen (Germany, F.R.). Hauptbereich Reaktortechnik). Oct 1980. BMFT-VB-K—77-12, January 1978. 35p. NTIS, PC A03/MF A01.

After the first fuel element change, crud deposits from three KWO (Obrigheim Nuclear Power Plant) fuel elements (No. 52, 62

and 64) were removed and investigated. The weight per unit area and chemical composition were determined. ^{58}Co was found to be primarily responsible for the radioactivity of the crud, followed by ^{54}Mn, ^{51}Cr, ^{60}Co, ^{59}Fe and ^{95}Zr. The ^{239,240}Pu, ^{241}Am and ^{242}Cm contents were determined for one series of crud specimens.

4782 **Experimental value of percent variation in root-mean-square ex-core detector signal to the core barrel amplitude scale factor.** Thompson, J.P.; McCoy, G.R.; Lubin, B.T. (Combustion Engineering, Inc., Windsor, CT). *USNuclear Technology (U. S.)Supersedes Nuclear Applications and Technology;* **48**: No. 2, 122-127(Apr 1980).

Ex-core neutron detector and core barrel-mounted accelerometer signals were used to determine the ratio of percent variation in the ex-core signal to core barrel amplitude. Based on these data, the nominal value, includig uncertainties, is 1.60 +- 0.24%/mm (0.0407 +- 0.006%/mil). This result is in agreement with both predictions, based on a one-dimensional transport model, and previously reported data.

4783 **Conductivity liquid level detector for the nuclear reactor environment.** Schwarz, W.F. (US DOE, Idaho Falls, Idaho). *USIEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) (U.S.);* **NS-27**: No. 1, 808-813(Feb 1980). (CONF-791037—).

From IEEE nuclear science/nuclear power systems symposium; San Francisco, CA, USA (17 Oct 1979).

An electrical conductivity-sensitive liquid level transducer (LLT) has been developed for and used in the pressurized water reactor (PWR) environment. Local conductivity at each of a vertical stack of electrodes is sampled in continual sequence and the presence or absence of water during each sample interval at each electrode is determined. The LLT was developed for use in test facilities which replicate the PWR environment. Qualification of the LLT for use in commercial nuclear generating stations is not and never was an objective. However, accumulated operating experience with the LLT plus recent improvements in data reduction and in materials processing indicate that an LLT could probably be fabricated and qualified for use in commercial reactors. 10 refs.

2103 Power Reactors, Non-breeding, Graphite Moderated

4784 **(COO—4057-13(Vol.2)) Gas Reactor International Cooperative program. Pebble bed reactor plant: screening evaluation. Volume 2. Conceptual balance of plant design.** (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Nov 1979. Contract EN-77-C-02-4057. 211p. NTIS, PC A10/MF A01.

This report consists of three volumes which describe the design concepts and screening evaluation for a 3000 MW(t) Pebble Bed Reactor Multiplex Plant (PBR-MX). The Multiplex plant produces both electricity and transportable chemical energy via the thermochemical pipeline (TCP). The evaluation was limited to a direct cycle plant which has the steam generators and steam reformers in the primary circuit. This volume describes the conceptual balance-of-plant (BOP) design and was prepared by United Engineers and Constructors, Inc. of Philadelphia, Pennsylvania. The major emphasis of the BOP study was a preliminary design of an overall plant to provide a basis for future studies.

4785 **(COO—4057-13(Vol.3)) Gas Reactor International Cooperative program. Pebble bed reactor plant: screening evaluation. Volume 3. Appendix A. Equipment list.** (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Nov 1979. Contract EN-77-C-02-4057. 255p. NTIS, PC A12/MF A01.

This report consists of three volumes which describe the design concepts and screening evaluation for a 3000 MW(t) Pebble Bed Reactor Multiplex Plant (PBR-MX). The Multiplex plant produces both electricity and transportable chemical energy via the thermochemical pipeline (TCP). The evaluation was limited to a direct cycle plant which has the steam generators and steam reformers in the primary circuit. Volume 1 reports the overall plant and reactor system and was prepared by the General Electric Company. Core scoping studies were performed which evaluated the effects of annular and cylindrical core configurations, radial blanket zones, burnup, and ball heavy metal loadings. The reactor system, including the PCRV, was investigated for both the annular and cylindrical core configurations. Volume 3 is an Appendix containing the equipment list for the plant and was also prepared by United Engineers and Constructors, Inc. It tabulates the major components of the plant and describes each in terms of quantity, type, orientation, etc., to provide a basis for cost estimation.

4786 **(DOE/SF/02034—T6) 1170MW(t) HTGR process steam/cogeneration. Design and cost report.** (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). 1 May 1980. Contract AC03-78SF02034. 180p. NTIS, PC A09/MF A01.

This report describes an 1170 MW(t) HTGR Process Steam/Cogeneration Plant Design and includes drawings and descriptions of major plant structures and systems. Descriptions and drawings of a coal plant designed to equivalent criteria are also included for comparison purposes. Total investment cost and an economic analysis of the evaluated cost of energy produced by each plant for various capacity factors and plant start-up dates are also included.

4787 **(GA-A—15859) Postirradiation examination of capsules GF-1, GF-2, and GF-3.** Kovacs, W.J.; Blanchard, R.; Pointud, M.L. (General Atomic Co., San Diego, CA (USA); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1980. Contract AT03-76ET35300. 248p. NTIS, PC A11/MF A01.

The GF-1, GF-2, and GF-3 capsule tests were irradiated in the Siloe reactor at Grenoble, France, between October 31, 1973, and July 25, 1975. High-enriched uranium (HEU) mixed oxide $(8Th,U)O_2$ fissile and ThO_2 fertile particles were tested over the following exposure conditions: 3.8 to 11.0 x 10^{25} n/m^2 (E > 29 fJ)/sub HTGR/; 960° to 1120°C time volume average temperature; and mixed oxide $(8Th,U)O_2$ burnup between 5.3 and 11.4% FIMA and ThO_2 burnup between 1.1 and 3.6% FIMA. Postirradiation examination of HTGR fuel rods in capsules GF-1, GF-2, and GF-3 showed acceptable structural integrity and irradiation-induced dimensional changes that were consistent with model predictions. Pressure vessel failure levels between different TRISO-coated $(8Th,U)O_2$ fissile particle types showed that the 400-μm-diameter kernel design was more conservative than the 500-μm-diameter designs.

4788 **(GA-A—15969) Pre- and postirradiation evaluation of fuel in capsule HRB-14.** Young, C.A. (General Atomic Co., San Diego, CA (USA)). Sep 1980. Contract AT03-76ET35300. 185p. NTIS, PC A09/MF A01.

Capsule HRB-14 was irradiated jointly by Oak Ridge National Laboratory and General Atomic Company (GA). This report covers the pre- and postirradiation characterization and evaluation of the GA fuel. The experiment was primarily to characterize the irradiation performance of TRISO-coated low-enriched $(Th,U)O_2$, $UC_{0.7}O_{0.5}$, and UO_2 particles and TRISO ThO_2 particles. Twenty cured-in-place fuel rods containing the fuel particles were irradiated at 960° to 1130°C. The fluence was 4.5 to 8.3 x 10^{25} n/m^2 (E > 29 fJ)/sub HTGR/. The fertile burnup was 4.1% to 8.5% fissions per initial metal atom (FIMA); the mixed oxide burnup was 14.5% to 19.3% FIMA; the uranium fissile burnup was 27.9% to 29.5% FIMA.

4789 **(GA-A—16057) HTGR-process steam/cogeneration and HTGR-steam cycle program. Semiannual report, October 1, 1979-March 31, 1980.** (General Atomic Co., San Diego, CA (USA)). Sep 1980. Contract AT03-76ET35301. 107p. NTIS, PC A06/MF A01.

Progress in the design of an 1170-MW(t) High-Temperature Gas-Cooled Reactor (HTGR) Nuclear Steam Supply (NSS) is described. This NSS can integrate favorably into present petrochemical and primary metal process industries, heavy oil recovery operations, and future shale oil recovery and synfuel processes. The economics appear especially attractive in comparison with alternative coal-fired steam generation. Cost estimates for central station power-generating 2240- and 3360-MW(t) HTGR-Steam Cycle

(HTGR-SC) plants are updated. The 2240-MW(t) HTGR-SC is treated to a probabilistic risk evaluation. Compared with the earlier 3000-MW(t) design, the results predict a slightly increased risk of core heatup, owing to the result of eliminating the capability of the boiler feed pump to operate at atmospheric backpressure. The differences in risk, however, are within the calculational uncertainties. Preliminary results of the ranking of safety enhancement features for the 1170-MW(t) HTGR indicate that the following modifications offer the most promise: (1) capability for main loop rundown, (2) natural circulation core auxiliary cooling, and (3) PCRV blowdown capability through the helium purification system to minimize activity release during some core heatups.

4790 **(GA-A—16154) Fission product behavior in the Peach Bottom and Fort St. Vrain HTGRs.** Hanson, D.L.; Baldwin, N.L.; Strong, D.E. (General Atomic Co., San Diego, CA (USA)). Nov 1980. Contract AT03-76ET35300. 15p. NTIS, PC A02/MF A01.

Actual operating data from Peach Bottom and Fort St. Vrain were compared with code predictions to assess the validity of the methods used to predict the behavior of fission products in the primary coolant circuit. For both reactors the measured circuit activities were significantly below design values, and the observations generally verify the codes used for large HTGR design.

4791 **(ORNL/TM—7507) Characterization of three fibrous insulations for potential HTGR application.** Selle, J.E. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01.

Three fibrous insulation materials manufactured by Babcock and Wilcox were characterized for possible use as HTGR core thermal insulations. These materials (Unifelt 3000 board, Unifelt 2600 board, and Kaowool blanket) were characterized by spectrographic analysis, x-ray diffractometry, scanning electron microscopy, ignition studies and bulk density measurements, resilience tests, helium permeation tests, and compressive stress-strain tests. Of these properties, resilience is the most important for determining acceptability of material for HTGR use. The arbitrary resilience acceptability criterion is 90% or greater after 20 h at 816°C (1500°F). Based on the resilience test, the Unifelt 3000 was acceptable, the Unifelt 2600 was marginal, and the Kaowool was unacceptable.

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REFER ALSO TO CITATION(S) 4847, 4866, 4869, 4873, 4874, 4875, 4881, 4882, 4889, 4890, 4892, 4893, 4894

4792 **(ANL—80-72) Neutron-induced helium implantation in GCFR cladding.** Yamada, H.; Poeppel, R.B.; Sevy, R.H. (Argonne National Lab., IL (USA)). Oct 1980. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01.

The neutron-induced implantation of helium atoms on the exterior surfaces of the cladding of a prototypic gas-cooled fast reactor (GCFR) has been investigated analytically. A flux of recoil helium particles as high as 4.2 x 10^{10} He/cm^2.s at the cladding surface has been calculated at the peak power location in the core of a 300-MWe GCFR. The calculated profile of the helium implantation rates indicates that although some helium is implanted as deep as 20 μm, more than 99% of helium particles are implanted in the first 2-μm-deep layer below the cladding surface. Therefore, the implanted helium particles should mainly affect surface properties of the GCFR cladding.

4793 **(ANL—80-104) Improved algorithms for the calculation of resolved resonance cross sections with applications to the structural Doppler effect in fast reactors.** Hwang, R.N.; Toppel, B.J.; Henryson, H. II. (Argonne National Lab., IL (USA)). Oct 1980. Contract W-31-109-ENG-38. 59p. NTIS, PC A04/MF A01.

Motivated by a need for an economical yet rigorous tool which can address the computation of the structural material Doppler effect, an extremely efficient improved RABANL capability has been developed utilizing the fact that the Doppler broadened line shape functions become essentially identical to the natural line shape functions or Lorentzian limits beyond about 100 Doppler widths from the resonance energy, or when the natural width exceeds about 200 Doppler widths. The computational efficiency has been further enhanced by preprocessing or screening a significant number of selected resonances during library preparation into composition and temperature independent smooth background cross sections. The resonances which are suitable for such pre-processing are those which are either very broad or those which are very weak. The former contribute very little to the Doppler effect and their self-shielding effect can readily be averaged into slowly varying background cross section data, while the latter contribute very little to either the Doppler or to self-shielding effects. To illustrate the accuracy and efficiency of the improved RABANL algorithms and resonance screening techniques, calculations have been performed for two systems, the first with a composition typical of the STF converter region and the second typical of an LMFBR core composition. Excellent agreement has been found for RABANL compared to the reference Monte Carlo solution obtained using the code VIM, and improved results have also been obtained for the narrow resonance approximation in the ultra-fine-group option of MC^2-2.

4794 **(CONF-801107—42) Burnup effects in data sensitivity studies.** White, J.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The broad areas of data sensitivity and uncertainty analysis have received much attention over the last several years, with most of the analyses performed to date being restricted to time-independent problems. However, recent theoretical and computational developments in time-dependent generalized perturbation theory have created considerable interest in time-dependence data sensitivity and uncertainty analyses. The purpose of this work is to outline a data sensitivity formulation based on depletion perturbation theory (DPT) and to illustrate the effects of fuel burnup in a typical data sensitivity calculation.

4795 **(CRBRP-GEFR-SP—220) Fabrication technology: LMFBR steam generators.** Spalaris, C.N.; Ring, P.J.; Wright, E.A. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Aug 1980. Contract AT03-76SF70030. 20p. (CONF-801036—6). NTIS, PC A02/MF A01.

From Special topical meeting - materials performance in nuclear steam generators; St Petersburg Beach, FL, USA (6 Oct 1980).

Reliability of LMFBR steam generators is of greater importance than that of fossil-fired boilers. Aside from reduced plant availability, the consequences of failures experienced in sodium heated steam generators results in expensive recovery operations. If realistic and cost effective measures are taken, fabrication procedures can be upgraded to offer greater service reliability without substantial increases in fabrication costs. These measures must be instituted during the planning stages and continue through the fabrication, testing, installation, plant startup and operation phases. This report describes work done to support specific upgrading of the fabrication process involving 2-1/4Cr-1Mo construction material. Selection of materials specification features are reviewed, together with the tangible benefits experienced through the fabrication campaign and the selective testing performed on tube-to-tubesheet specimens. Weld criteria, methods of inspection, and post weld heat treatment parameters are reviewed. Results are reviewed from tests that establish verification of potentially higher component quality than can be obtained from normal industry practice.

4796 **Radionuclide trap for liquid-metal-cooled reactors.** McGuire, J.C.; Brehm, W.F. (Hanford Engineering Development Lab., Richland, WA). *USNuclear Technology (U. S.)Supersedes Nuclear Applications and Technology;* **48**: No. 2, 101-109(Apr 1980).

Prototype radionuclide traps were tested in sodium loops containing irradiated sources (Source Term Control Loops 2 and 3) at 604 and 538°C (1120 and 1000°F). Prototype traps were 70 to 87% efficient in removing ^{54}Mn from the sodium, and also effective for ^{60}Co. Extensive screening tests showed that pure nickel is the most effective getter material, working best above 450°C (842°F)

with increasing effectiveness at higher temperatures. Of the several possible trap sites considered for reactor use, a location within the top of the fuel assembly was chosen as the most convenient and effective. This position would facilitate trap handling by making trap insertion and removal an implicit part of the normal fuel handling procedure. A cost/benefit analysis shows that the radionuclide trap will be economically attractive.

4797 **(GA-A—15949) CALIOP: a multichannel design code for gas-cooled fast reactors. Code description and user's guide.** Thompson, W.I. (General Atomic Co., San Diego, CA (USA)). Oct 1980. Contract AT03-76SF71023. 116p. NTIS, PC A06/MF A01.

CALIOP is a design code for fluid-cooled reactors composed of parallel fuel tubes in hexagonal or cylindrical ducts. It may be used with gaseous or liquid coolants. It has been used chiefly for design of a helium-cooled fast breeder reactor and has built-in cross section information to permit calculations of fuel loading, breeding ratio, and doubling time. Optional cross-section input allows the code to be used with moderated cores and with other fuels.

4798 **(GA-A—16062) Requirements for the GCFR plenum streaming experiment.** Perkins, R.G.; Rouse, C.A.; Hamilton, C.J. (General Atomic Co., San Diego, CA (USA)). Sep 1980. Contract AT03-76SF71023. 63p. NTIS, PC A04/MF A01.

This report gives the experiment objectives and generic descriptions of experimental configurations for the gas-cooled fast breeder reactor (GCFR) plenum shield experiment. This report defines four experiment phases. Each phase represents a distinct area of uncertainty in computing radiation transport from the GCFR core to the plenums, through the upper and lower plenum shields, and ultimately to the prestressed concrete reactor vessel (PCRV) liner: (1) the shield heterogeneity phase; (2) the exit shield simulation phase; (3) the plenum streaming phase; and (4) the plenum shield simulation phase.

4799 **(GEFR-SP—063) Core mechanics and configuration behavior of advanced LMFBR core restraint concepts.** Fox, J.N.; Wei, B.C. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Feb 1978. Contract AT03-76SF71031. 10p. (CONF-780609—20). NTIS, PC A02/MF A01.

From ASME/CSME pressure vessels and piping conference; Montreal, Canada (25 Jun 1978).

Core restraint systems in LMFBRs maintain control of core mechanics and configuration behavior. Core restraint design is complex due to the close spacing between adjacent components, flux and temperature gradients, and irradiation-induced material property effects. Since the core assemblies interact with each other and transmit loads directly to the core restraint structural members, the core assemblies themselves are an integral part of the core restraint system. This paper presents an assessment of several advanced core restraint system and core assembly concepts relative to the expected performance of currently accepted designs. A recommended order for the development of the advanced concepts is also presented.

4800 **(HEDL-SA—2125-FP) Neutron and gamma characterization within the FFTF reactor cavity.** Bunch, W.L.; Carter, L.L.; Moore, F.S.; Werner, E.J.; Wilcox, A.D.; Wood, M.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1980. Contract AC14-76FF02170. 17p. (CONF-800942—20). NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

Neutron and gamma ray measurements were made within the reactor cavity of the Fast Flux Test Facility (FFTF) to establish the operating characteristics of the Ex-Vessel Flux Monitoring (EVFM) system as a function of reactor power level. A significant effort was made to obtain absolute flux values in order that the measurements could be compared directly with shield design calculations. Good agreement was achieved for neutrons and for both the prompt and delayed components of the gamma ray field. 8 figures, 3 tables.

4801 **(ORNL/TM—7455) System design description for GCFR-core flow test loop.** Huntley, W.R.; Grindell, A.G. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 129p. NTIS, PC A07/MF A01.

The Core Flow Test Loop is a high-pressure, high-temperature, out-of-reactor helium circulation system that is being constructed to permit detailed study of the thermomechanical and thermal performance at prototypic steady-state and transient operating conditions of simulated segments of core assemblies for a GCFR Demonstration Plant, as designed by General Atomic Company. It will also permit the expermental verification of predictive analytical models of the GCFR core assemblies needed to reduce operational and safety uncertainties of the GCFR. Full-sized blanket assemblies and segments of fuel rod and control rod fuel assemblies will be simulated with test bundles of electrically powered fuel rod or blanket rod simulators. The loop will provide the steady-state and margin test requirements of bundle power and heat removal, and of helium coolant flow rate, pressure, and temperature for test bundles having up to 91 rods; these requirements set the maximum power, coolant helium flow, and thermal requirements for the loop. However, the size of the test vessel that contains the test bundles will be determined by the bundles that simulate a full-sized GCFR blanket assembly. The loop will also provide for power and coolant transients to simulate transient operation of GCFR core assemblies, including the capability for rapid helium depressurization to simulate the depressurization class of GCFR accidents. In addition, the loop can be used as an out-of-reactor test bed for characterizing in-reactor test bundle configurations.

4802 **Rotating plug size study for liquid-metal fast breeder reactors.** Nemeth, L.J. (General Electric Co., Sunnyvale, CA). *USNuclear Technology (U. S.)Supersedes Nuclear Applications and Technology;* **48**: No. 2, 117-121(Apr 1980).

A study was performed to evaluate possible rotating plug arrangements. The three-, two-, and one-rotating plug schemes were developed using a set of established restrictions and component sizes. The three-rotating plug configuration is the recommended reference design.

4803 **International conference on fast breeder reactor fuel performance.** Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979). 967p. (CONF-790306—).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Seventy-eight papers and one abstract are included which discuss integral fuel rod tests, properties and mechanisms, design and modeling, and advanced and alternate fuels. Separate abstracts were prepared for 54 of the papers; the remaining 24 were previously abstracted. (DLC)

4804 **Irradiation performance of mixed oxide fuel pins: Japanese experience.** Uematsu, K.; Ishida, Y.; Komatsu, J.; Kawata, T. pp 16-28 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Within the frame of Japanese program of developing fast breeder reactors, the Power Reactor and Nuclear Fuel Corporation (PNC) has made intensive efforts in conducting irradiation testing of oxide fuel pins in foreign and domestic reactors. During the past ten years, a total of 155 fuel pins has been irradiated in both thermal and fast flux conditions. This paper summarizes experiences obtained to date with respect to fuel pin behaviors including thermal performance, fuel dimensional changes, cladding deformations and fuel-cladding chemical interactions. 8 figures.

4805 German oxide fuel pin irradiation test experience for fast reactors. Kummerer, K.R. pp 29-42 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

As to the steady-state operation of representative oxide fuel, pins and bundles up to a burnup of 60 MWd/kg M and higher, many experimental results are available which cover a wide field of design and irradiation parameters. The short-term behavior of pins during startup as well as power changes and power ramping were investigated. The experiments carried out under abnormal conditions indicated that pin failures caused by fabricational defects, coolant disturbances or power transients have only limited consequences on failure propagation and fuel coolant interaction. There is an acceptable experimental basis for a sound reference oxide fuel element design. 9 figures, 8 tables.

4806 Prediction and follow up of the behavior of fuel subassemblies and of experimental irradiation in the Phenix breeder. Coulon, P. (CEA, Marcoule, France); Carnoy, M. pp 43-52 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The followup on the operation of the Phenix core showed that the fuel behavior is good and, therefore, helped in the prolongation of the subassemblies irradiation time. The designed specific burnup, which was 50,000 MWj/t is regulary exceeded. Moreover, a thorough knowledge of the core characteristics has allowed improved performance. Design power which was of 563 MW(t) is generally exceeded, the operating power being closer to 585 MW(t). Finally, the correct behavior of the fuel, at the level of the standard subassemblies and at that of the experimental irradiation, has been expressed by the lack of cladding failures after 4 years of operation. At most, the presence of some unsealed pins can be reported, accompanied by an emission of fission gas only, which did not disturb the reactor operation. 4 figures.

4807 Mixed oxide fuel performance. Edmonds, E.; Sloss, W.; Bagley, K.Q.; Batey, W. pp 53-63 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Following the final shutdown of DFR in March 1977, the examination of irradiation experiments from the last reactor loading has continued. These have included subassemblies at up to 14.7% burnup with four intermediate examinations and single fuel pins at up to 21% burnup which have been examined at ten burnup increments. Results are presented on clad strain development as a function of temperature, neutron dose, burnup and cladding material and on microstructural features of both fuel and clad.

4808 Irradiation of GCFR test fuel bundles in the BR-2 helium-loop Mol. Krug, W.; Euringer, H.; Jung, W.; Vanmassenhove, C.; Campana, R.J. pp 79-86 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The HELM irradiations being carried out in BR-2 are compared with the GCFR demonstration plant. The pressure equalization system in GCFR is discussed. Fission gas releases from the bundle were measured. Tritium and iodine measurements were also made. (DLC)

4809 Defect pin behaviour in the DFR. Sloss, W.M.; Bagley, K.Q.; Edmonds, E.; Potter, P.E. pp 112-122 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

A program of defective fuel pin irradiations has been carried out in the DFR. This program employed fuel pins which had failed during previous irradiations (natural defects) and pins in which simulated failures (artificial defects) had been induced prior to irradiation or during an intermediate examination stage at moderate or substantial burnups. The artificial defects simulated longitudinal ruptures and were normally located at positions near the top, middle and bottom of the pin where clad temperatures were 450, 540 and 630°C respectively. The fuel was mixed U-Pu oxide, and fuel form, stoichiometry, clad type, pin diameter, linear rating, and burnup were among the variables examined. The defect pin tests were normally carried out in single pin or trefoil type vehicles. After irradiation all the pins were subjected to the normal nondestructive examination procedures and the visual, radiographic, gamma-scanning, and dimensional change results are presented. Several pins were destructively examined and the metallographic data are discussed.

4810 Cladding deformations in rapsodie and consequences. Marbach, G.; Millet, P.; Peray, R. pp 123-132 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Numerous tests on Rapsodie Fortissimo core fuel elements have provided solid data on their behavior for burnup values on the order of 14 at. %, corresponding to clad doses of 11.5 x 10^{22} n/cm^2, i.e. approximately 80 dpa. More specifically, on the basis of the results obtained with one such subassembly, clad deformation and its effects on oxide thermal patterns can be analyzed in detail. Deformations remain limited in solution-annealed AISI 316 steel clad tubes the mean diameter increase for the 61 fuel pins was 6%. It is shown that this deformation is attributable both to steel swelling and to clad creep resulting from the pressure of the fission gases released by the oxide; this creep phenmenon corresponds to the irradiation creep relation: $\epsilon = A\ \delta\ .\ phi\ t$, but with a thermally activated creep modulus A, at least at high temperatures. The oxide surface temperature increased with respect to its initial temperature, reaching approximately 1500°C, while the oxide central temperature (approx 2070°C) decreased. this evolution is explained by the reduced oxide-clad transfer coefficient, the formation of a central void and the drop in linear power during irradiation.

4811 Aspects of restructuring in oxide fuels. Paris, R.; Horspool, J.M.; Bellamy, R.G. pp 133-142 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Within the limits of the rating and clad temperature uncertainties, the following conclusions are drawn: the outer limit of dendritic grain formation revelaed by prolonged etching is the end of life melt boundary; annular pellet fuel is relatively stable up to 60 kW/m but melting and axial fuel movement are extensive at 70 kW/m; fresh vibrofuel undergoes centre melting above 465 kW/m +- 10% if raised to power in 2h or less; further irradiation of this fuel at or below 50 kW/m improves its thermal conductance and restores a more uniform fuel distribution; vibrofuel raised rapidly to power and subsequently irradiated above 50 kW/m remains unsta-

ble, with melting and axial fuel movement; at high ratings plutonium is transported up the temperature gradient in both pellet and vibrofuel, enriching an annulus around the central void and depleting the intermediate zone; an irregular uranium rich rim is formed on highly rated vibrofuel. A vapor transport mechanism is proposed; pronounced radial or axial enrichment of plutonium could be due to repeated fuel melting. 8 figures, 2 tables.

4812 **Irradiation performance of WSA-3, -4 and -8 mixed-oxide fuel pins in grid-spaced assemblies.** Levine, P.J.; Nayak, U.P.; Schwallie, A.L.; Boltax, A. pp 143-154 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Purpose of the three irradiation assemblies in EBR-II was to evaluate mixed-oxide fuel pin and grid-spacer behavior in fast reactors. In all cases, the behavior of the pins and the grid-spacer system was excellent. The behaviors of the three subassemblies are compared. 11 figures. (DLC)

4813 **Swelling, densification and creep of oxide and carbide fuels under irradiation.** Dienst, W.; Muelle-Lyda, I.; Zimmermann, H. pp 166-175 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Fuel swelling in fuel pins under irradiation may lead to undue deformation of the cladding the limit of which, in fast reactors, is constituted primarily by the low ultimate elongation of the irradiated cladding tubes. However, also processes leading in the opposite direction must be taken into account, which may delay the volume increase of swelling fuel or reduce the contact pressure it exerts on the cladding. Such opposite effects are radiation induced densification of porous fuel and radiation induced creep in that fuel temperature zone in which thermal sintering and creep do not yet exert any major influence. Fuel behavior in this zone generally determines the mechanical interaction between the fuel and the cladding. The parameter dependences of the processes mentioned are described and discussed in this report in the light of experimental findings. 4 figures.

4814 **Material transport processes and their effects in fast breeder mixed oxide fuel.** Schumacher, G. pp 279-291 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The redistribution of the constituents of irradiated fuel is calculated using physical transport models and compared with postirradiation examinations. Actinides, oxygen, and fission products are discussed separately. 6 figures. (DLC)

4815 **Application of a cluster model of oxygen thermomigration to fast reactor fuel behaviour.** Norris, D.I.R.; Simpson, K.A. pp 292-300 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Several models exist to describe theromigration effects in mixed oxide fast reactor fuel, (U,Pu)O/sub 2-x/. The cluster model for the solid state mechanism is considered the most generally applicable. Oxygen redistribution in the presence of a temperature gradient affects fuel centre temperatures through the sensitivity of thermal conductivity to oxygen to metal ratio. Thermomigration effects relate a mean fuel O/M ratio to a local O/M at some point in the fuel pins such as a buffer would maintain.

4816 **Study of the thermal behaviour of LMFBR fuel.** Conte, M. (Dept. d 'Etude des Combustibles a Base de Plutonium, Fontenay-aux-Roses, France); Gatesoupe, J.P.; Trotabas, M.; Boivineau, J.C.; Cosoli, G. pp 301-319 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Results are: The in-pile radial migration of oxygen which was accurately measured for the first time does not follow the theoretical models proposed up to now, especially in the hot part of the fuel. The thermal conductivity of an irradiated oxide fuel is most probably modified by irradiation both as a function of temperature and as a function of the O/M ratio. Lastly, a quick closure of the fuel-cladding gap was observed which is surprising for these moderate temperatures. We belive that such a fast diametral expansion of the fuel during the very first power ramp could only be explained by a decrease of hydrostatic density in the fuel through the cases initially present as impurities in the fuel. If this phenomenon was to be confirmed, it would be the most important observation, since it might then be possible to hope for a self-moderation of the beginning of life maximum temperatures obtained during reactor startup thanks to the closure of the fuel-cladding gap. 9 figures, 4 tables.

4817 **Migration behavior of cesium in mixed oxide fuel pins.** Uematsu, K.; Ishida, Y.; Komatsu, J.; Kawata, T. pp 384-392 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Migration behavior of cesium was examined for fast reactor mixed oxide fuel pins. Cesium migrate radially and axially to the cooler region of fuel pins. Axial accumulation of cesium is observed at the interface of fuel/UO_2 insulator pellets and pellet to pellet gaps. For high burnup and high power pins, cesium accumulation are sometimes observed within the fuel column. And it appears to increase the irregular redistributions of cesium within the fuel column with increasing the burnup and power. A secondary gray phase is often observed at the fuel/UO_2 insulator interface and fuel cladding gaps. Microprobe analysis revealed the presence of uranium, cesium, iodine, tellurium and barium and no plutonium in this reaction zone. Thus the gray phase may be formed by UO_2-cesium reactions. These local cesium accumulations sometimes induced the cladding strain at fuel/UO_2 insulator interface and within the fuel column. The strain appears to be resulted from the volume increase of UO_2-cesium reaction products. The cesium accumulation is influenced by oxygen to metal ratio and temperature gradients. However, these local accumulation of cesium does not seem to limit the fuel performance. 4 figures.

4818 **Chemical state of irradiated uranium-plutonium oxide fuel pins.** Kleykamp, H. pp 393-404 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The chemical state is influenced by compositional changes induced by the fission process, and by the transport and reaction of the fuel components and the fission products in the temperature gradient. A thermodynamic assessment was conducted in order to establish the composition and to determine the melting point and stoichiometry shift during burnup. 8 figures. (DLC)

4819 Review of examinations and considerations on cladding distension by mechanical interaction with the fuel in fast breeder fuel pins. Dienst, W.; Mueller-Lyda, I. pp 468-477 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Cladding strain due to mechanical interaction with the fuel can produce cracks in the cladding. This paper deals with the processes underlying this interaction, their dependence on specific parameters, and their representation in models. Those processes include fuel swelling, cesium reaction, thermal differential expansion, gap closure, densification, creep, etc. 5 figures. (DLC)

4820 Techniques for studying inner cladding corrosion in irradiated LMFBR pins. Coquerelle, M.; Pickering, S.; Ray, I.L.F.; Walker, C.T.; Whitlow, W.H. (Commission of the European Communities, Karlsruhe, Germany). pp 498-512 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The following general conclusions may be drawn from electron microscopic and micro-probe analysis examinations. The cladding was corroded intergranularly and complex grain boundary phases were formed. This together with corrosion at the surface resulted in depletion effects in the cladding, particularly of chromium, accompanied by phase changes (austenite to a ferritic phase) and precipitation of $M_{23}C_6$ type carbides. At least two ceramic phases were found in the fuel/cladding gap, that adjacent to the cladding containing principally uranium, cesium and a little molybdenum, the other containing cesium and chromium (note that light elements may also have been present. A metallic phase containing principally iron and nickel was observed adjacent to the fuel. The presence of this phase was particularly interesting because it demonstrated that not all the metal lost from the inner cladding surface was converted to ceramic (oxide) phases: i.e. metal loss at the inner cladding surface was not due entirely to classical corrosion processes. 10 figures.

4821 Fuel-claddng mechanical interaction in fast reactor fuel rods. Biancheria, A.; Roth, T.S.; Nayak, U.P.; Boltax, A. pp 513-535 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The major points are summarized below. In general, oxide fuels undergo less FCMI than helium-bonded carbide fuels during steady-state conditions whereas the opposite is true for overpower transient conditions. Most of the cladding damage in $(U,Pu)O_2$ fuel rods is generated during overpower transients. $(Th,Pu)O_2$ fuel rods generally show more FCMI and cladding damage than $(U,Pu)O_2$ for both steady-state and transient conditions. FCMI stresses and cladding damage are generally higher in ThO_2 blanket rods than in UO_2, UC, or ThC blankets. the latter three blanket concepts undergo only little damage from FCMI. A detailed study revealed that while damage in $(U,Pu)O_2$ fuel rods was significantly reduced when cladding thickness was increased in the range of 0.30 to 0.50 mm, helium-bonded (U,Pu)C fuel rods showed little or no benefit from increasing thickness. These results indicate that cladding thinner than currently considered can be utilized in helium-bonded carbide fuels.

4822 Mechanism and prediction of fuel-cladding chemical interaction in mixed-oxide fuel pins at high burnup: evidence for cladding component chemical transport. Adamson, M.G.; Aitken, E.A. pp 536-550 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Compelling evidence is presented for the occurrence of fission product-induced cladding component transport into the fuel in irradiated stainless steel-clad oxide fuel pins. This phenomenon, morphological aspects of which are described, is most evident in fuel pins with high O:M fuels (> 1.97), cladding i.d. temperatures exceeding 600°C, and burnups of 5 at. % or greater. The proposed mechanism for this essentially chemical process (CCCT) involves dissolution of Fe, Ni, Cr, etc., by a liquid Cs, Te fission product medium and transport as dissolved species up the steep thermal gradient between the cladding and the fuel. A calculational model based on the thermodynamics and kinetics of this process is presented and used to analyze available inpile results. The CCCT process is thus shown to constitute an additional FCCI mechanism that contributes to cladding inner surface wastage at burnups exceeding ca 5 at. %. It is suggested that CCCT plays an important role in the observed axial peaking of FCCI-induced cladding inner surface wastage in long, commerical-type LMFBR fuel pins.

4823 Analysis of mechanical interaction between fuel pellet and cladding. Ishida, M.; Sakagami, M.; Kikuchi, S. pp 559-568 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

A computer code, MIPEC-RZ, was developed for predicting steady-state fuel pellet-clad mechanical interaction (PCMI). Analytical models used in MIPEC-RZ are described and some calculations for a few sample problems are discussed. 5 figures. (DLC)

4824 Statistical analysis and parameter study of chemical fuel/cladding interaction of SNR-typical fast flux experiments. Biermann, W.K. (Interatom, Bergisch Gladbach, Germany); Haas, D.; Heuvel, H.J. pp 569-579 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

A correlation has been presented, which fits the average corrosion depth measured in several typical SNR 300 Mk Ia pin irradiation experiments. This correlation emphasizes the influence of the initial fuel O/M ratio on the corrosion depth (strong increase between 1.96 and 1.98) and the analogy, in what concerns temperature dependence, with a thermal activated process beyond a threshold temperature. Some important questions remain, however, open, like the corrosion behavior at high temperature (beyond 660°C) and the role played by other parameter in the corrosion mechanism. Concerning the high scattering of the experimental results, one can conclude that its origins should be found in the large amount of the fabrication and irradiation parameters, on one hand, and in the nature of the FCCI and of the measurements method in the other hand. To eliminate this scattering seems very unlikely, especially in what concerns the second origin. For design calculations, two possible philosophies can be followed: to work with average values, as shown in this paper, or to remain conservative, as has been done for the design of SNR Mk Ia. 5 figures.

4825 Some observations on the carburisation of mixed oxide pin clad in the Dounreay Fast Reactor. Bellamy, R.G.; Paris, R. pp 580-584 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

DFR fuel pin cladding was carburized by mixed oxide fuel and to a greater extent by the NaK coolant. The highest a surface carbon levels produced by the coolant would have been cause for concern in a pin endurance assessment but in the event appear to have had no deleterious effect. The degree of penetration of the cladding was strongly temperature dependent, as expected from a diffusion process. The surface carbon contents did not show the inverse temperature dependence predicted by theory, possibly because the method of deducing surface carbon from subsurface carbon measurement is susceptible to kinetic effects. The carbon diffusion profiles obtained under irradiation can be fitted to a Fick's law calculation with the added assumption of a surface carbon content increasing linearly with time to its equilibrium value. This additional requirement appears to be related to the low coolant carbon activities in-pile relative to the coolant carbon activities in out-of-pile experiments.

4826 Distribution of fission products released from breached mixed-oxide, carbide, nitride, and metallic-uranium fuels in EBR-II. Villarreal, R. pp 585-596 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Fission products released from the cladding breach of a U-Pu oxide, carbide, nitride, or metallic uranium fuel element during EBR-II operation were found to adhere to the cladding surface of the breached element and adjacent elements. These fission products are believed to be entrained in the fission gas jet-stream issuing from the breach and impinging on the cladding surface of the adjacent elements. Milligram quantities of fission products have been found deposited around the breach and on the cladding surfaces of adjacent nonruptured elements just opposite the breach. A series of smears taken along the axial length of the ruptured fuel pin may indicate the location of ruptures since fission products adhere to the stainless steel cladding in the upward direction of sodium flow. Radioanalyses of smears for U and Pu alpha-activity indicate the absence or presence of fuel particles around the breach. 3 figures, 7 tables.

4827 Analysis of fission product release from vented LMFBR fuel pins. Cecchi, P.; Scandola, G. pp 597-606 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The venting device operation appears quite sensitive to the pressure and, perhaps, temperature conditions, so the final demonstration of feasibility has to be obtained in fast reactor environment and in reference conditions. Nevertheless the VN experiments gave a series of highly positive answers. The DISCA venting device performed satisfactorily in steady-state conditions up to high burn-up. No plugging problems arose in the venting device nor in the integrated vibrocompacted blanket. Reduction in the released activity was consistent for short-lived fission gases and can be improved for ^{133}Xe if the pin operates at reactor pressure conditions. The coolant contamination by ^{137}Cs and ^{131}I was kept at extremely low level. Non-steady-state operation and mild overpower transient appear to have little influence on release of activity and on coolant contamination.

4828 Release of fission products from artifically defected LMFBR oxide fuel pins. Jacobi, S.; Schmitz, G. pp 607-618 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The in-pile behavior of UO_2- and $(U,Pu)O_2$- pins with simulated fuel cladding defects was studied in the FR2-HSD loop and in the SILOE-Thermopump loops. The release rates of short-lived Br- and J-isotopes showed major deviations from the values anticipated from the recoil model calculations. In case of sodium as coolant, the release mechanism is controlled by diffusion in a $Na_5(U,Pu)O_4$ layer and the calculated k-factors is between 4 and 51 whilst in the case of steam as coolant, the k-factors lie between 0,7 and 553. The release rates of the noble fission gases determined by gamma spectroscopy were of the same order of magnitude as those of the neutron precursors Br and J.

4829 Evaluation of fast breeder reactor fuel pin performance during normal operation. Harbourne, B.L.; Patel, M.R.; Stephen, J.D.; Sundquist, B.E.; Billone, M.C.; Dutt, D.S.; Ostermeier, B.J. pp 619-641 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The LIFE code has been developed using a fundamental approach to modelling of thermo-structural phenomena which jointly determine fuel pin behavior. LIFE 3 has been verified against experimental data and applied to design analyses and to the interpretation of test data. LIFE 4, containing several upgraded fuel behavior models, has been partially verified and exercised in a typical design analysis. The results from verification and applications show that the LIFE codes are an essential component of the system of core design methods. In addition to this function, the LIFE code represents a nationally recognized tool for the evaluation and understanding of experimental data. Development is continuing, based on the acquisition of new data, and new demands for design analyses. 5 figures, 4 tables.

4830 Modelling of fast reactor fuel transient behavior using the life code. Roth, T.S.; Atcheson, D.B.; Biancheria, A.; Billone, M.C.; Stephen, J.D.; Sundquist, B.E. pp 642-654 of International conference on fat breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

An initial set of LIFE transient codes has been derived from the steady-state modelling effort principally by the addition of a transient heat transfer capability which has been verified by analysis of thermal benchmark problems. The ability of the transient code to accept temperatures from another thermal hydraulics code has been shown. Modifications have been made to handle the specialized environment of a TREAT static NaK irradiation vehicle, and analysis of an oxide and a carbide fuel experiment was performed. In the HOP3-1B oxide 3$/sec transient experiment analysis, good agreement between measured and calculated Ni heat sink temperatures and cladding deformation was obtained. The transient LIFE code was used in design of the HC2 carbide 50 cent/sec transient experiment. The probability of cladding breach was calculated as a function of the peak power achieved in the transient. This probability and the calculated cladding strain agreed with the results of the experiment. Analysis of advanced alloy cladding for helium bonded carbide and oxide fuel pin designs showed that a low swelling high strength cladding can restrain oxide fuel swelling, wereas this type of cladding leads to high FCMI with carbide fuel. Transient code development will continue in the future with the addition of high strain rate deformation fuel melting, and transient fission gas behav-

ior models and with the comparison of code results to a broad range of experimental results.

4831 LMFBR fuel pin modeling with the computer codes COMETHE III-J and IAMBUS. Van Vliet, J. (Belgonucleaire, S.A., Brussels, Belgium); Pay, A.; Toebbe, H.; Steinmetz, B. pp 655-664 of International conference on fat breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

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IAMBUS and COMETHE, developed by Interatom and Belgonucleaire respectively, have been compared from numerical methods and models standpoints. While sharing a lot of common models, leading to similar description of steady-state pin behavior, differences exist that made the two codes complementary. The calculation results related to start-up rams (COMETHE) and power ramps (IAMBUS) were presented here to illustrate their capabilities. Both codes were tested against representative LMFBR experiments and appeared to be both in fair agreement with P.I.E. results. The complementarity of COMETHE and IAMBUS capabilities allows a cross-checking of their outputs. This is believed to improve the confidence in the fuel pin optimization and design calculations, which are performed commonly by Interatom and Belgonucleaire for the DeBeNe fast breeder project SNR-300.

4832 FRUMP: a physically based fuel model. Wilmore, D.; Matthews, J.R. pp 665-674 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

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The development of FRUMP has not just given us a useful tool for gauging the performance of LMFBR fuel; it has also increased our understanding of the basic processes underlying fuel behavior and has stimuated the construction of physical models of this behavior. It is at this point that we may now consider producing simpler models for use in design and accident analysis. Unless the underlying mechanisms are understood empirical or simplified treatments can be misleading. 3 figures.

4833 Evaluation of FBR fuel irradiation behaviour using a hybrid computer. Ishii, T.; Mizuno, M.; Kubota, T. pp 675-685 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

We are considering with the necessity of the fuel management system on the site of the reactor which is used to follow up the fuel rod behavior under operation. A large size fuel performance code FIBER-2 has been developed, but this code is not suitable for repeated analyses of a large number of fuel pins. For the purpose of the evaluation of fuel integrity in the fuel management system, a simplified code FIBER-H is under development. A simplification of PCMI and restructuring models is one of main tasks in the development of FIBER-H. For a simplification of PCMI evaluation, the quantitative relation between cladding strain and PCMI parameters are obtained by parametric survey using FIBER-2. And the statistical analyses of PIE data performed to deduce empirical equations for fuel resturcturing. 9 figures.

4834 Design and performances improvements of commercial fast reactors subassemblies using PHENIX experience. Arnaud, G. (Centre d'Etudes Nuclearies de Cadarache, Saint-Paul-les Durance, France); Bernard, A.; Dupouy, J. pp 709-724 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

PHENIX core monitoring provides full scale experimental data on subassemlby behavior and on parameter limits. This paper discusses the distortions observed on the subassemblies - primarily on the outer hexagonal tubes - and their consequences on the design of future subassemblies for fast neutron reactors. Reference is made to experimental irradiations on new, higher performance structural materials. 8 figures.

4835 Fuel pin and assembly design limits and criteria. Vijuk, R.M.; Dutt, D.S.; Stephen, J.D. pp 725-737 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Structural design criteria have been formulated using an approach similar to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code and related code cases for nuclear reactor components. Intent of these criteria is to summarize previous design criteria for FBR core components and provide a guide for national standardization of design criteria. These criteria intend to preclude the failure modes through systematic analytical evaluation or in combination with component tests. The design criteria, their associated limits and the analysis methods are related. For example, application of either of two optional sets of design rules is allowed. Generally, a more detailed structural and damage analysis method allows smaller design margins.

4836 Aspects of LMFBR-oxide and carbide fuel element design and analysis with respect to thermodynamic and fluid-dynamic optimized grid and wire space subassemblies. Hoffmann, H.; Weinberg, D. (Kernforschungszentrum, Karlsruhe, Germany). pp 747-757 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

With respect to the best possible equal coolant temperature increase in all bundle subchannels (f/sub T/ = 1.0 at f/sub q/ = 1.0) the thermohydraulic optimization of bundle geometries yielded a linear relation f/sub T/ = f(f/sub q/). These variables and dependencies are influenced by bundle anomalties and not affected by the fuel (oxide/carbide). The calculations show: bundle geometries exist where only grid spacers can be used (great value of P, small value of D) as well as such where only helical spacers are eligible (small value of P, great value of D); an intermediate range can be defined for LMFBR subassemblies where both solutions are possible. In this range a nonoptimized bundle geometry allows to use grids and helical spacers. However, grids generally yield more favorable conditions than wires. Inluence of tolerances (bundle eccentricities) on f/sub T/ = f(f/sub q/) prevail in both ranges. Optimized grids yield an influence of tolerances on f/sub T/ = f(f/sub q/) and this applies also to optimized helical spacers, although a transition is required to wire concepts with smaller wire diameters on the outer row of rods, compared to the inner rows. Only advanced versions - grids with a skirt/wires with a flexible linear - are optimum and of equal value in comparison wth each other. Other aspects than thermohydraulic ones (i.e. hot spots, means of fabrication) will then be important to design and discuss these concepts.

4837 Advanced concepts for fuel assembly design. Kaplan, S.; Stephen, J.D.; Vijuk, R.M.; Jackson, R.J. pp 758-776 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Improvements in assembly design can be made to reduce the deleterious effects of bundle-duct and duct-duct interactions on as-

sembly lifetime, and to improve performance in general. Several advanced wire and grid spacer concepts have been tested out-of-reactor and in EBR-II. Testing will continue in FTR. All test results thus far are positive. 8 figures.

4838 **Fast neutron reactor fuel elements and power grid duty cycling.** Rousseau, J.; Chalony, A.; Ackett, C.; Decuyper, J.D. pp 777-782 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The PHENIX power grid cycling operation in 1982-1983 will allow verification of the models and criteria developed in the interim. It will provide indispensible statistical data and will open the way to power grid duty for Super PHENIX beginning in 1986. Although at the present time it is impossible to resolve the question of weekly or daily load variations, it is felt that fast neutron reactor fuel subassemblies should provide satisfactory performance for primary and secondary frequency adjustments.

4839 **Advanced sub-assembly design for CDFR.** Gatley, J.A. pp 783-791 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The design now proposed for the fuel subassembly of CDFR is directly developed from that of PFR. A number of changes have been made to improve the structural behavior of the core under the damaging influence of a fast neutron flux, and the design has also been modified to reduce costs and improve breeding. A number of details have been introduced to facilitate ultimate disassembly during reprocessing. None of these changes involves great extrapolation from the existing PFR design, and they can all be endorsed by the experimental and theoretical development program now in hand in the United Kingdom. The penalties entailed in reducing core coolant temperatures of temperature rises have been quantified. They are not insignificant. As there are no insuperable difficulties in designing primary circuit structures to accept the present reference temperatures, it is not proposed to pursue lower temperature designs.

4840 **Advanced/alternate breeder fuels testing in the US.** Bennett, J.W.; Norman, E.C.; Cox, C.M.; Adamson, M.G.; Boltax, A.; Kittel, J.H. pp 793-803 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

New activities were initiated in 1977 on the design and fabrication of alternate uranium-233 breeding (Th/Pu) and denatured (U/U) fuels irradiation tests in EBR-II in both oxide and carbide fuel forms. The primary objective of these tests and the accompanying ex-reactor properties studies is to develop comparative performance information on these fuels versus the better known uranium-based (U/Pu) fuels. Also initiated in 1977 were planning activities on particulate and metal fuels to form the basis for early cycle FFTF irradiation tests if a decision were made to pursue the development of these fuel forms. More recently, results from core and system design studies conducted in the 1977-1978 time period, in combination with an assessment of the evolving US position regarding potentially acceptable breeder reactor fuel cycles, resulted in a clearer definition of the direction which should be taken in the US on advanced/alternative fuels. Emphasis in the 1978-1979 time frame will be on the EBR-II and FFTF testing efforts on (U/Pu) carbide fuels and on the design and fabrication of thorium blanket FFTF irradiation tests, while maintaining an oxide fuel option for LPDS.

4841 **Helium- and sodium-bonded mixed-nitride fuel performance.** Bauer, A.A. (Battelle Columbus Labs., OH); Cybulskis, P.; Petty, R.L.; DeMuth, N.S. pp 827-841 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Recent PIE data for sodium-bonded mixed-nitride fuel provide promising support for the shrouded-fuel design concept for preventing fuel-clad mechanical interaction until the fuel cladding gap is consumed. Mechanical interaction apparently is precluded since the Type 316 stainless steel appears to begin swelling at a rate greater than the fuel before the gap is consumed. These data also indicate very low fission-gap release rates for the mixed-nitride fuel and a lack of chemical reaction with the stainless steel cladding. Irradiation tests of helium-bonded fuel elements have resulted in a number of test element failures. The only design feature common to all elements was a small (nominal 0.127 mm) gap; two of the elements were loaded with high-density fuel pellets and one with low-density pellets. Diametral expansions were found to be related to smear density with gap size influencing the results. A linear dependence of diametral expansions on burnup is indicated. Helium-bonded elements fabricated with a small gap (0.127 mm) and containing fuel with pellet densities in excess of 88% of theoretical exhibit severe ridging. The ridge peaks coincide with pellet-pellet interfaces. Element failure is not related to ridging. 5 figures.

4842 **Performance analysis of helium-bonded carbide and nitride fuel pins.** Boltax, A.; Nayak, U.P.; Skalka, R.J.; Biancheria, A. pp 842-852 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Recent experimental data from the current US Advanced Fuels Development Program provide the basis for a major upgrading of the performance analysis capabilities of the LI and nitride fuel pins. The changes in the LIFE-3C code are illustrated by a comparison of current and prior predictions of the behavior of FFTF helium-bonded carbide fuel pins. Results of performance analysis studies are also presented for breached carbide and nitride fuel pins irradiated in EBR-II. 3 figures, 2 tables.

4843 **Performance of FBR core designs with alternative fuel.** Weber, C.E.; Lowery, V.W.; Biancheria, A.; Omberg, R.P. pp 879-896 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

To identify key reactor/fuel cycle performance characteristics, a multi-contractor effort has been completed namely the Preconceptual Core Design Study. Key results of this study not reported in detail by the participating contractors are presented in this paper to provide background for this session with emphasis placed on fuel design and performance analysis. A total of eighteen designs were developed in this study. The 1000 MW(e) designs were developed using a multidiscipline approach. The analyses were performed with rigor sufficient to firmly establish the performance characteristics of the designs. A set of ground rules was developed to insure consistency and comparability among the designs in the study. These ground rules contained a set of nuclear, mechanical, and thermal-hydraulic design procedures and constraints which were agreed upon by all designers involved in the study.

4844 Design of carbide fueled LMFBR cores. Noyes, R.C.; Klinetob, R.H.; Kulwich, M.R. pp 897-909 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

A table summarizes what core performance studies tell about the best way to design carbide fuel pins. It is reassuring to note that newer studies are not pointing in a direction much different from the older studies. However, when further in-depth studies of heterogeneous carbide cores are complete, we may see significant new directions. 5 figures, 6 tables.

4845 Optimization of a carbide fuel element for low doubling time: general considerations and their impact on carbide fuel element development. Mougniot, J.C.; Recolin, J.; Colin, M.; Rouault, J. pp 910-924 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

A doubling time less than or equal to 15 years is possible with the carbide type fuel element in numerous technological configurations. From these results the two references were selected which seemed best suited to French circumstances. In both cases the most critical manufacturing parameter is smear density which must be kept to the highest possible value; swelling and mechanical interaction studies must therefore proceed with this objective in mind. On the other hand, one must not forget that the results obtained in the (most likely optimistic) hypotheses of a 1 year out-of-pile time may need to be questioned in the case of longer out-of-pile times. Nevertheless, at the present moment, the problem of out-of-pile time is not solved for oxide type fuel elements any more than for carbide type elements. Therefore, arbitrary values for this parameter must be chosen for computations. It is important to note that carbide type fuel elements always compare favourably with oxide type fuel elements when out-of-pile times are approximately the same for both fuels. 11 figures.

4846 Metallic fuels systems for alternative breeder fuel cycles. Kittle, J.H. (Argonne National Lab., IL); Johnson, D.L.; Beck, W.N.; Horak, J.A. pp 925-934 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Metal fuels are the subject of renewed interest as part of the US effort to develop advanced fuels for alternative breeder fuel cycles. Metal fuels in the uranium-plutonium, thorium-uranium, and thorium-plutonium systems have been developed or identified that appear to have adequate thermal performance at current temperatures of interest for advanced LMFBRs. Also, a metal fuel element design concept has been developed with demonstrated capability of achieving fuel burnups of 10 a/o or more with high reliability. Existing information on the candidate metal fuel systems has been reviewed and applied to develop design and operating envelopes for the fuel elements of advanced LMFBRs employing alternative breeder fuel cycles.

2108 Economics

REFER ALSO TO CITATION(S) 4780, 4888, 4954

4847 (COO—2250-40) Evaluation of the breed/burn fast reactor concept. Atefi, B.; Driscoll, M.J.; Lanning, D.D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Dec 1979. Contract AS02-76ET37241. 296p. (MITNE—229). NTIS, PC A13/MF A01.

A core design concept and fuel management strategy, designated breed/burn, has been evaluated for heterogeneous fast breeder reactors. In this concept internal blanket assemblies after fissile material is bred in over several incore cycles, are shuffled into a moderated radial blanket and/or central island. The most promising materials combination identified used thorium in the internal blankets (due to the superior performance of epithermal Th-U233 systems) and zirconium hydride (ZrH_{16}) as the moderator (because of the compact assembly and core designs it permitted).

4848 (ORNL/TM—7177) Once-through CANDU reactor models for the ORIGEN2 computer code. Croff, A.G.; Bjerke, M.A. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 64p. NTIS, PC A04/MF A01.

Reactor physics calculations have led to the development of two CANDU reactor models for the ORIGEN2 computer code. The model CANDUs are based on (1) the existing once-through fuel cycle with feed comprised of natural uranium and (2) a projected slightly enriched (1.2 wt % ^{235}U) fuel cycle. The reactor models are based on cross sections taken directly from the reactor physics codes. Descriptions of the reactor models, as well as values for the ORIGEN2 flux parameters THERM, RES, and FAST, are given.

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 4926, 5565

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 4794, 5552

4849 (CONF-801107—33) Neutron wave propagation in heterogeneous media and the interpretation of neutron noise in BWRs. Difilippo, F.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Experimental data from boiling water reactors (BWRs) show that the phase of the cross-power spectral density between pairs of axially separated neutron detectors varies linearly with frequency (characteristic of a pure delay process) for frequencies greater than ~ 1 Hz. The interpretation of this fact is of relevance to application of noise techniques to measure the average velocity of the vapor phase in the moderator. It is shown that the homogeneous approximation is inadequate to interpret the noise field in the BWRs despite the number of energy groups used. To show this point, a single-energy-group, neutron diffusion model which accounts explicitly for the heterogeneities of the system is presented.

4850 (ORNL/TM—7485) User's guide for SAMMY: a computer model for multilevel r-matrix fits to neutron data using Bayes' equations. Larson, N.M.; Perey, F.G. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 92p. (ENDF—297). NTIS, PC E03/MF $3.50.

Includes 1 sheet of 48 reduction microfiche.

A method is described for determining the parameters of a model from experimental data based upon the utilization of Bayes' theorem. This method has several advantages over the least-squares method as it is commonly used; one important advantage is that the assumptions under which the parameter values have been determined are more clearly evident than in many results based upon least squares. Bayes' method has been used to develop a computer code which can be utilized to analyze neutron cross-section data by means of the R-matrix theory. The required formulae from the R-matrix theory are presented, and the computer implementation of

both Bayes' equations and R-matrix theory is described. Details about the computer code and compelte input/output information are given.

2202 Components And Accessories

4851 **(LA-UR—80-2858) Category I structures: safety margin at ultimate load.** Anderson, C.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 12p. (CONF-8010124—1). NTIS, PC A02/MF A01.

From 8. annual light water reactor safety meeting; Washington, DC, USA (31 Oct 1980).

The objective of the program described in this paper is to supply test information needed to assess the structural capability of Category I structural systems that are loaded beyond their design limits. The program activities were started in the latter half of FY 1980. The activities for FY 1981 are to continue the development of structural test plans, initiate design, construction and testing of small structures, continue to develop and perform analytical prediction of limit states, and to complete a US Reactor Concrete Structural Technology Report. In FY 1982, the testing of concrete structural systems will take place along with analytical modeling of selected experimental tests.

4852 **(WAPD-TM—1457) Specified assurance level sampling procedure.** Willner, O. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Nov 1980. Contract AC11-76PN00014. 86p. NTIS, PC A05/MF A01.

In the nuclear industry design specifications for certain quality characteristics require that the final product be inspected by a sampling plan which can demonstrate product conformance to stated assurance levels. The Specified Assurance Level (SAL) Sampling Procedure has been developed to permit the direct selection of attribute sampling plans which can meet commonly used assurance levels. The SAL procedure contains sampling plans which yield the minimum sample size at stated assurance levels. The SAL procedure also provides sampling plans with acceptance numbers ranging from 0 to 10, thus, making available to the user a wide choice of plans all designed to comply with a stated assurance level.

4853 **Hydrogen permeation resistant barrier.** McGuire, J.C.; Brehm, W.F. (to Dept. of Energy). US Patent Application 119,740. 8 Feb 1980. 8p.

A hydrogen permeation resistant barrier is formed by diffusing aluminum into an iron or nickel alloy and forming an intermetallic aluminide layer.

2203 Fuel Elements

4854 **Nondestructive assay of subassemblies of various spent or fresh fuels by active neutron interrogation.** Ragan, G.L.; Ricker, C.W.; Chiles, M.M.; Ingersoll, D.T.; Slaughter, G.G. (Oak Ridge Natl Lab, Tenn). *USNuclear Materials Management (U.S.);* **8**: 334-343(1979). (CONF-790707—).

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

Recent studies show that subassemblies containing various spent fuels could be assayed rapidly and accurately by a nondestructive assay system using active neutron interrogation and prompt-neutron detection. Subassembly penetration is achieved by 24-keV (Sb-Be) interrogation neutrons; the spent-fuel neutron background is overridden by using strong interrogating sources and prompt-neutron signals, and background gammas are absorbed by lead. Experiments have demonstrated the potential for assaying, with better than 5% accuracy, three spent plutonium-fueled subassemblies per hour. Calculations, validated by experiments, predict even better performance for fresh or uranium-fueled subassemblies; several performance estimates are given. 2 refs.

4855 **Development of physical models of fission gas behaviour in nuclear fuels under operational and transient conditions.** Wood, M.H.; Hayns, M.R. pp 176-187 of International conference on fast brceder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

This paper reviews recent progress in the understanding of the behavior of the fission gases produced during reactor operation and outlines the capabilities of some current models. The following areas were highlighted as specifically relevant to the development of physical models, and requiring particular attention in the future: experimental clarification of the role of random bubble motion by electron microscopy; experimental determination of the mechanism and velocities of bubble migration in a temperature gradient for the various bubble sizes and conditions pertaining in-pile; further experimental and theoretical studies relevant to determining the mechanism and magnitude of the fission induced re-solution of gas atoms from bubbles, especially in a fast reactor environment; the development of simple and reliable physically based models for describing gas release and swelling during operational and transient conditions; and the inclusion of these models into general fuel element modelling codes.

4856 **Influence of design and operating parameters on mixed-oxide fuel power-to-melt.** McCarthy, W.H.; Jedlovec, D.R.; Vaidyanathan, S.; Hilbert, R.F. pp 268-278 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Eighteen (U,Pu) mixed-oxide fuel rods have been destructively examined after EBR-II irradiation at peak liner powers of 50 to 70 kW/m (15 to 21 kW/ft) in the GE-F20 experiment. This power was sufficient to cause a limited amount of fuel melting. Twelve of these rods had been pre-irradiated at 40 to 50 kW/m (12 to 16 kW/ft) to produce some fuel restructuring and to affect thermal performance during the subsequent high-power exposure. Three of the twelve were again irradiated at 40 to 50 kW/m following operation at 50 to 70 kW/m. The intent of these three rods was to explore restructuring effects in axially relocated once-molten fuel. Nine sibling rods were irradiated at 40 to 50 kW/m, without any high-power exposure, to assess the fuel structure prior to the high-power operation of the partially melted fuels. Fuel density, fuel-cladding gap thickness, and burnup were major variables investigated. This paper describes some of the fuel microstructural observations from the F20 experiment. The effects of prior irradiation and fuel variables are outlined.

4857 **Effect of fuel density on fuel-cladding mechanical interaction.** Vaidyanathan, S.; Hilbert, R.F. pp 460-467 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Fuel smear density is considered to be an important variable in determining the extent of fuel-cladding mechanical interaction and thereby pin lifetime. The results of the study presented in this paper indicate that for the mixed uranium-plutonium oxide fuel system, smear density by itself is not the controlling variable. Data based inferences and analytical evaluations show that a combination of smear density and gap size controls the extent of this interaction. In particular, the results show that relative to a reference smear density of 85.5% of theoretical density with a 0.125mm diametral gap, smear density could be increased on the order of 1% per 0.025mm increase in the fuel cladding diametral gap size for the same mechanical interaction. 4 figures, 2 tables.

4858 Thermochemical model for fuel-cladding chemical interactions in oxide pins. Goetzmann, O. pp 489-497 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The model enables explanations for some irregularities in the appearance of attack, e.g., the reduction of cladding attack at higher temperature positions in the pin. It demonstrates effectively the significant influence the rod power has on cladding attack. This influence of the rod power varies as it affects the fuel surface temperature and the temperature difference across the fuel cladding gap. In comparing the behavior of pins with different diameters the surface heat flux should, therefore, be considered as the relevant parameter. This correlation is indicated by the results of more recent British irradiation experiments. Two bundles were irradiated with similar rod power (~ 600 W/cm) and cladding temperatures. One bundle failed, the other stayed intact. The failed pins had smaller diameters. At the same rod power they had to experience a higher surface heat flux (and higher fuel surface temperature) than the thicker pins. The rod power also has an effect on the O/M increase during burnup. At higher fuel temperatures less oxygen can be gettered by complex oxide formation, so the fuel is more prone to be oxidized to higher O/M-ratios.

2204 Control Systems

REFER ALSO TO CITATION(S) 4888

4859 Nuclear science symposium, 26th and symposium on nuclear power systems, 11th, 1979. Kerns, C.R. (Ed.). (Fermilab, Batavia, Ill). *USIEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) (U.S.);* **NS-27**: No. 1, vp(Feb 1980). (CONF-791037—).

From IEEE nuclear science/nuclear power systems symposium; San Francisco, CA, USA (17 Oct 1979).

Proceedings include 163 of the papers presented at the combined meetings, as well as two papers delivered at the plenary session on plant control beyond the 1980's and ionizing radiation dose hazards. One-hundred-and-sixty-two papers are indexed separately. Nuclear Science symposium included calorimeters and specific ionization (17 papers); PWC and Drift Chambers (7 papers); photo/optical detectors (10 papers); semiconductor detectors (11 papers); nuclear circuits and systems (11 papers); space instrumentation (9 papers); medical instrumentation (30 papers); data preprocessing (6 papers); data acquisition (11 papers); environmental instrumentation (15 papers); reactor instrumentation (16 papers). Fifteen Nuclear Systems Symposium papers covered: safety, RFI effects, detectors, monitoring systems, reactor protection, multiplexing of circuits, standard application, emergency planning and preparedness and operator/instrumentation interactions.

4860 Microprocessor controlled digital period meter. Keefe, D.J.; McDowell, W.P.; Rusch, G.K. (Argonne Natl Lab, Ill). *USIEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) (U.S.);* **NS-27**: No. 1, 318-321(Feb 1980). (CONF-791037—).

From IEEE nuclear science/nuclear power systems symposium; San Francisco, CA, USA (17 Oct 1979).

A microprocessor controlled digital period meter has been developed and tested operationally on a reactor at Argonne National Laboratory. The principle of operation is the mathematical relationship between asymptotic periods and pulse counting circuitry. This relationship is used to calculate and display the reactor periods over a range of /plus or minus/1 second to /plus or minus/999 seconds. The time interval required to update each measurement automatically varies from 8 seconds at the lowest counting rates to 2 seconds at higher counting rates. The paper will describe hardware and software design details and show the advantages of this type of Period Meter over the conventional circuits. 1 ref.

2205 Environmental Aspects

4861 (GA-A—16084) Reactor siting risk comparisons related to recommendations of NUREG-0625. Barsell, A.W.; Dombek, F.S.; Orvis, D.D. (General Atomic Co., San Diego, CA (USA)). Nov 1980. Contract AT03-76ET35300. 44p. NTIS, PC A03/MF A01.

This document evaluates how implementing the remote siting recommendations for nuclear reactors (NUREG-0625) made by the Siting Policy Task Force of the US Nuclear Regulatory Commission (NRC) can reduce potential public risk. The document analyzes how population density affects site-specific risk for both light water reactors (LWRs) and high-temperature gas-cooled reactors (HTGRs).

4862 (ORNL/TM—6402) Sources of tritium. Phillips, J.E.; Easterly, C.E. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 60p. NTIS, PC A04/MF A01.

A review of tritium sources is presented. The tritium production and release rates are discussed for light water reactors (LWRs), heavy water reactors (HWRs), high temperature gas cooled reactors (HTGRs), liquid metal fast breeder reactors (LMFBRs), and molten salt breeder reactors (MSBRs). In addition, release rates are discussed for tritium production facilities, fuel reprocessing plants, weapons detonations, and fusion reactors. A discussion of the chemical form of the release is included. The energy producing facilities are ranked in order of increasing tritium production and release. The ranking is: HTGRs, LWRs, LMFBRs, MSBRs, and HWRs. The majority of tritium has been released in the form of tritiated water.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 4887, 5240

4863 (HEDL-SA—2211) Preventive maintenance and load testing of fixed position cranes in support of major operations. Detrick, C.K. (Hanford Engineering Development Lab., Richland, WA (USA)). 23 Jul 1980. Contract AC14-76FF02170. 22p. (CONF-8010122—1). NTIS, PC A02/MF A01.

From Hanford maintenance conference; Richland, WA, USA (1 Oct 1980).

This paper will address load testing and preventive maintenance of fixed in-place cranes in general, and maintenance and load testing of the 200 ton Polar Gantry Crane at the FFTF in particular. This paper also covers the installation of a 100-ton bridge crane in the FFTF's Reactor Service Building, as well as use of these cranes in making important lifts of FFTF equipment.

4864 Critical experiments with solid neutron absorbers and water-moderated fast test reactor fuel pins. Durst, B.M. (Battelle-Pacific Northwest Labs., Richland, WA); Bierman, S.R.; Clayton, E.D.; Mincey, J.F. *USNuclear Technology (U.S.)Supersedes Nuclear Applications and Technology;* **48**: No. 2, 128-149(Apr 1980).

A series of experiments was performed at the Battelle-Pacific Northwest Laboratories on water-flooded arrays of Fast Test Reactor fuel elements (PuO_2-UO_2) intermixed with solid neutron absorbers. The objective of these experiments was to provide reliable experiment data that could be used to benchmark computer codes and calculational schemes commonly used in criticality analysis of such systems. The neutron absorbers used were cadmium and Boral plates and gadolinium cylindrical rods. Critical array sizes were determined for square lattice pitches ranging from 9.7 to 24.9 mm, corresponding to water-to-fuel volume ratios of 3.5 to ~ 31 (hydrogen atom to fissile atom ratios of 58 to 473). For both systems, poisoned and unpoisoned, the minimum number of rods required for criticality occurred at a lattice pitch of ~ 20.5 mm, which also corresponds to a water-to-fuel volume ratio of 20.5.

4865 **Microprocessor controlled multipoint recorder with graphical video output for reactor core temperatures.** McDowell, W.P. (Argonne Natl Lab, Ill). *USIEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) (U.S.);* **NS-27**: No. 1, 783-787(Feb 1980). (CONF-791037—).

From IEEE nuclear science/nuclear power systems symposium; San Francisco, CA, USA (17 Oct 1979).

Many nuclear reactors and experimental facilities use multipoint strip chart recorders for the measurement of temperature and other data. These recorders have several serious deficiencies, including: lack of display visibility, poor data format, poor operator interaction and the requirement for a great deal of maintenance activity. To eliminate these problems and provide the operator with a quick, accurate method of displaying recorded data, a microprocessor controlled multipoint recorder has been developed. This unit uses a video monitor to display data in graphical form and a magnetic tape recorder to provide archival storage and data retrieval. This study describes the hardware and software design details of this device and describes its use.

2209 Reactor Safety

4866 **(ANL—80-63) TRANS4: a computer code calculation of solid fuel penetration of a concrete barrier.** Ono, C.M.; Kumar, R.; Fink, J.K. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 42p. NTIS, PC A03/MF A01.

The computer code, TRANS4, models the melting and penetration of a solid barrier by a solid disc of fuel following a core disruptive accident. This computer code has been used to model fuel debris penetration of basalt, limestone concrete, basaltic concrete, and magnetite concrete. Sensitivity studies were performed to assess the importance of various properties on the rate of penetration. Comparisons were made with results from the GROWS II code.

4867 **(CONF-801103—22) Nonsafety loads on glass 1E power sources, revisited.** Lewin, J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The supply of some nonsafety loads from class 1E power sources is allowed by industry standards (IEEE Standards 308 and 384) and by US Nuclear Regulatory Commission Regulatory Guides 1.32 and 1.75. This has been questioned as a possible source of degradation of the class 1E system, and this power deals with assessment of the effects of this practice on the reliability of the power supply for engineered safety features (ESF) systems.

4868 **(DOE/ET/34004—1) Management study of light water reactor radiation exposure. Final report, June 1979-September 1980.** Burg, R.J.; Flynn, J.J.; Gregg, B.R.; Nilsen, R. (Catalytic, Inc., Philadelphia, PA (USA)). Sep 1980. Contract AC02-79ET34004. 151p. NTIS, PC A08/MF A01.

Sources of radiation exposure are discussed and a model showing the growth of radiation fields is presented. Representative tasks where exposure is received are identified for both a PWR and a BWR. The relationship of radiation exposure and plant operations is discussed and an attempt to develop correlations between exposure data and operating data is presented. Methods of reducing occupational radiation exposure by contamination prevention, contamination removal and reducing the time in radiation areas are described. Current projects developing these methods are identified. The methods are evaluated for potential exposure reduction achievable by their implementation. Five methods are determined to have high exposure reduction potential. Two areas of advance technology are also identified as having significant potential. Schedules and costs are developed for implementation of the high potential methods. Possible influence by the DOE on these schedules is considered. Schedules for the development of the advanced technologies are projected both with and without work sponsored by the government.

4869 **(DOE/SF/70097—T2) Experimental investigation of the effect of nucleation surface area on nonequilibrium phenomena in flashing water.** Sanai, M.; Tobin, R.J. (SRI International, Menlo Park, CA (USA)). Sep 1980. Contract AT03-76SF70097. 58p. NTIS, PC A04/MF A01.

The nonequilibrium phenomena that occur in flashing water and the effect of nucleation surfaces on the flashing process were studied using a chamber and a piston. Following the piston release, the pressure dropped abruptly, but started to rise shortly after the piston was stopped. The pressure then reached a plateau and remained essentially constant during the 300-ms observation period. It was calculated that the flashing mixture is in a state of thermal nonequilibrium throughout the expansion and observation period. Addition of coaxial cylindrical inserts lowered the plateau pressure, indicating the formation of large, and hence cooler, vapor voids, contradicting the expectation that by merely adding surfaces and nucleation sites within the flashing mixture, the flashing process would approach equilibrium because a greater number of smaller-sized bubbles would be produced. A possible explanation for the observed behavior is the formation on the surfaces of vapor films, which tend to join and produce large vapor voids within the mixture. Similar vapor films and large voids may also occur during a prototypic core disruptive accident. This would tend to diminish the lower core pressure and hence reduce the slug impact on the cover.

4870 **(DOE/TIC—11356) Radiation release and health effects lessons from the Three Mile Island accident. Application to emergency response planning.** Mynatt, F.R.; Berger, C.D. (Oak Ridge National Lab., TN (USA)). 21 Nov 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

The Three Mile Island-2 accident and the ORNL response are discussed briefly. Three documents are reviewed in relation to emergency response planning for the Zimmer Nuclear Plant: NUREG-0610, NUREG-0654, and the Sequoyah emergency response plan. Distribution of potassium iodide tablets is not recommended. (DLC)

4871 **(DOE/TIC—11360) Radiation release and health effects lessons from the Three Mile Island incident: assessment of objective risks for emergency preparedness planning.** Berger, C.D.; Mynatt, F.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

The accepted theories of radiation health effects are briefly discussed so that the Three Mile Island health effects estimations can be better understood. The author recommends that emergency response planners weigh the objective risks rather than the perceived risks of low-level radiation against those associated with evacuation of large population zones before a final plan is put into effect. (ACR)

4872 **(EPRI-NP—1382) PWR FLECHT SEASET 21-rod bundle flow blockage task. Task plan report. FLECHT SEASET Program report No. 5.** Hochreiter, L.E.; Basel, R.A.; Dennis, R.J.; Lee, N.; Massie, H.W. Jr.; Loftus, M.J.; Rosal, E.R.; Valkovic, M.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Oct 1980. 424p. (NUREG/CR—1370; WCAP—9658). NTIS, PC A18/MF A01.

This report presents a descriptive plan of tests for the 21-Rod Bundle Flow Blockage Task of the Full-Length Emergency Cooling Heat Transfer Separate Effects and Systems Effects Test Program (FLECHT SEASET). This task will consist of forced and gravity reflooding tests utilizing electrical heater rods to simulate PWR nuclear core fuel rod arrays. All tests will be performed with a cosine axial power profile. These tests are planned to be used to determine effects of various flow blockage configurations (shapes and distributions) on reflooding behavior, to aid in development/assessment of computational models in predicting reflooding behavior of flow blockage configurations, and to screen flow blockage configurations for future 161-rod flow blockage bundle tests.

4873 **(GA-A—14789) Methodology for GCFR post-accident fuel containment analyses.** Kang, C.S. (General Atomic Co., San Diego, CA (USA)). Sep 1980. Contract AT03-76SF71023. 164p. NTIS, PC A08/MF A01.

A methodology has been developed and preliminary analyses have been performed to examine the capability of the 300-MW(e) Gas-Cooled Fast Breeder Reactor (GCFR) demonstration plant to contain the molten core debris inside its prestressed concrete reactor vessel following a postulated core meltdown accident. Results of the analysis indicate that the post-accident heat removal can be accomplished by providing a moderate amount of extra cavity liner cooling to remove the downward-flowing heat and using either forced helium with one core auxiliary cooling loop or natural circulation of helium to remove the upward-flowing heat. Based on the preliminary analyses, it appears that the current GCFR design with minor modifications may be feasible for post-accident fuel containment. However, design studies and more detailed analyses are required to support this conclusion.

4874 **(GA-A—15420(Vol.2)) Reliability studies for the gas-cooled fast breeder reactor residual heat removal systems. Volume II. Details of probabilistic analyses.** Taniguchi, T.; Raabe, P.H. (General Atomic Co., San Diego, CA (USA)). Sep 1980. Contract AT03-76SF71023. 301p. NTIS, PC A14/MF A01.

This report documents a number of probabilistic analyses that have been performed since 1977 on the heat removal trains and electric supplies of the residual heat removal systems in the gas-cooled fast breeder reactor (GCFR). Volume II consists of appendices containing detailed information of those analyses as a backup to the summary descriptions. In the main, the detailed descriptions in this volume have been developed from excerpts from internal memoranda that were prepared at the time the analyses were performed to provide necessary documentation thereof.

4875 **(GA-A—15421) Comparative safety assessment of upflow versus downflow GCFR core designs.** Frank, M.V.; Kang, C.S.; Reilly, J.T.; Wheeler, P.A. (General Atomic Co., San Diego, CA (USA)). Sep 1980. Contract AT03-76SF71023. 100p. NTIS, PC A05/MF A01.

This report presents a hypothetical core disruptive accident safety assessment and a post-accident fuel containment evaluation which were performed for the upflow versus downflow core design decision for the GCFR. Differences between the upflow and downflow unprotected accident sequences were not significant. However, differences do appear when potential accident mitigation and recriticality prevention design concepts are investigated for the loss of shutdown cooling and flow blockage accidents. An in-vessel molten fuel containment system is preferred over an ex-vessel system for both the upflow and downflow concepts.

4876 **(LA-UR—80-2194) Human error considerations and annunciator effects in determining optimal test intervals for periodically inspected standby systems.** McWilliams, T.P.; Martz, H.F. (Denver Univ., CO (USA); Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 27p. (CONF-810102—1). NTIS, PC A03/MF A01.

From 1981 annual reliability and maintainability symposium; Philadelphia, PA, USA (27 Jan 1981).

This paper incorporates the effects of four types of human error in a model for determining the optimal time between periodic inspections which maximizes the steady state availability for standby safety systems. Such safety systems are characteristic of nuclear power plant operations. The system is modeled by means of an infinite state-space Markov chain. Purpose of the paper is to demonstrate techniques for computing steady-state availability A and the optimal periodic inspection interval tau* for the system. The model can be used to investigate the effects of human error probabilities on optimal availability, study the benefits of annunciating the standby-system, and to determine optimal inspection intervals. Several examples which are representative of nuclear power plant applications are presented.

4877 **(NUREG/CR—1112) Light water reactor safety research program. Volume 12: quarterly report, Apr-Jun 79.** Berman, M. (Sandia Labs., Albuquerque, NM (USA)). May 1980. 163p. NTIS, PC A08/MF A01.

This report summarizes the progress of the Light Water Reactor Safety Research Program during the 2nd quarter of 1979. Specifically, the report summarizes progress in five major areas of research. They are: (1) the molten core/concrete interactions study; (2) steam explosion research phenomena; (3) statistical LOCA analysis; (4) UHI model development; (5) two-phase jet loads.

4878 **(NUREG/CR—1268) Structural integrity of water reactor pressure boundary components. Quarterly progress report, Oct-Dec 79.** Loss, F.J. (Naval Research Lab., Washington, DC (USA)). 20 Mar 1980. 71p. NTIS, PC A04/MF A01.

This report describes progress in a continuing program to characterize material properties performance with respect to structural integrity of light water reactor pressure boundary components. Progress under fracture mechanics investigations includes the first J-R curve trends from A533-B weld deposit irradiated under the HSST program. A new experimental procedure was developed for the testing of 0.5T-CT specimens by the single specimen compliance technique. Fatigue crack growth rates are being determined for a variety of pressure vessel and piping steels in simulated nuclear coolant environments. New results of cyclic crack growth on several pressure vessel steels are presented along with the results of the first test of irradiated A533-B steel, tested in the high-temperature pressurized water environment. Work in radiation sensitivity and post irradiation properties recovery has embarked on phase 2 of the irradiation-anneal-reirradiation (IAR) program. Investigations were continued on the postirradiation notch sensitivity of reactor vessel steels in a coordinated IAEA program.

4879 **(NUREG/CR—1293) Experiment data report for Semiscale Mod-3 Small Break Test Series (Tests S-SB-4 and S-SB-4A).** Arevalo, M.N.; Sackett, K.E. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1980. Contract DE-AC07-76IDO1570. 455p. NTIS, PC A20/MF A01.

Recorded test data are presented for Tests S-SB-4 and S-SB-4A of the Semiscale Mod-3 Small Break Test Series. These are two of several Semiscale tests conducted to investigate the thermal-hydraulic phenomena resulting from a small break loss-of-coolant accident (LOCA) in a pressurized water reactor system and to provide experimental data that can be used to assess the analytical capability of computer codes used in LOCA analysis. The primary objective is to determine the effect of Loss-of-Fluid Test (LOFT) initial conditions and configuration on system behavior during a small break loss-of-coolant experiment. Other objectives are to provide data for comparison with similar tests to be run in the LOFT facility and to investigate scaling effects pertinent to LOFT. This report's purpose is to make the uninterpreted data from Tests S-SB-4 and S-SB-4A available for future data analysis. The data have been analyzed only to the extent necessary to ensure that they are reasonable and consistent.

4880 **(NUREG/CR—1374) Shear transfer in large scale reinforced concrete containment elements. Technical report No. 1.** Oesterle, R.G.; Russell, H.G. (Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.). Apr 1980. 189p. NTIS, PC A09/MF A01.

This report presents first results of an experimental program to investigate shear transfer in a cracked containment vessel without diagonal reinforcement. The test setup was designed and constructed to simulate boundary conditions of a wall element of a pressurized containment subjected to tangential shear stresses. The experimental program included monotonic and reversing load tests on large scale specimens subjected to biaxial tension and shear. The specimens were 5-ft square and 2-ft thick with No. 14 and No. 18 reinforcement. Results of three monotonic tests are included in this report. The test variable was the level of biaxial tension. Observed behavior, strength and deformations are discussed.

4881 **(PNL—3135) Investigation of combined free and forced convection in a 2 x 6 rod bundle during controlled flow transients.** Bates, J.M.; Khan, E.U. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1980. Contract AC06-76RL01830. 139p. NTIS, PC A07/MF A01.

An experimental study was performed to obtain local fluid velocity and temperature measurements in the mixed (combined free and forced) convection regime for specific flow coastdown transients. A brief investigation of steady-state flows for the purely free-convection regime was also completed. The study was per-

formed using an electrically heated 2 x 6 rod bundle contained in a flow housing. In addition a transient data base was obtained for evaluating the COBRA-WC thermal-hydraulic computer program (a modified version of the COBRA-IV code).

4882 **(SAND—80-0691) Identification of significant problems related to light water reactor piping systems.** (URS/John A. Blume and Associates, Engineers, San Francisco, CA (USA)). Jul 1980. Contract AC04-76DP00789. 305p. (ALO—89; URS/Blume—7934). NTIS, PC A14/MF A01.

Work on the project was divided into three tasks. In Task 1, past surveys of LWR piping system problems and recent Licensee Event Report summaries are studied to identify the significant problems of LWR piping systems and the primary causes of these problems. Pipe cracking is identified as the most recurring problem and is mainly due to the vibration of pipes due to operating pump-pipe resonance, fluid-flow fluctuations, and vibration of pipe supports. Research relevant to the identified piping system problems is evaluated. Task 2 studies identify typical LWR piping systems and the current loads and load combinations used in the design of these systems. Definitions of loads are reviewed. In Task 3, a comparative study is carried out on the use of nonlinear analysis methods in the design of LWR piping systems. The study concludes that the current linear-elastic methods of analysis may not predict accurately the behavior of piping systems under seismic loads and may, under certain circumstances, result in nonconservative designs. Gaps at piping supports are found to have a significant effect on the response of the piping systems.

4883 **(LA-tr—80-35) German standard problem No. 4. Breakage of a feed-water pipe with a back-pressure valve, specification.** Grillenberger, T. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Oct 1980. Translation of German report, June 1980. 37p. NTIS, PC A03/MF A01.

When a feedwater pipe in a nuclear power plant breaks, backpressure valves close quickly to limit release of radioactive materials. To minimize the resulting water hammer, a fast-slow damped backpressure valve called SRV 350 has been developed. This valve is to be tested in a superheated steam reactor. The experimental setup and procedures for reporting the results are described. (DLC)

4884 **Critique of source term and environmental measurement at Three Mile Island.** Hull, A.P. (Brookhaven Natl Lab, Upton, NY). *USIEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) (U.S.);* **NS-27**: No. 1, 664-668(Feb 1980). (CONF-791037—).

From IEEE nuclear science/nuclear power systems symposium; San Francisco, CA, USA (17 Oct 1979).

The most serious malfunction to date at an operating power reactor in the U.S. occurred at Unit 2 of the Three Mile Island Nuclear Power Station (TMI) at 0400 EST (Eastern Standard Time) on March 28, 1979. Subsequently, between 3X and 10*10/sup 6/ Ci of radio gases (principally /sup 133/Xe) were released to the atmosphere from the plant vent in decreasing concentrations over the next few weeks, accompanied by about 10 Ci of /sup 131/I. During this period, the plant's typical effluent monitors and field radiation monitoring program were unable to supply prompt and reliable radiological information. 8 refs.

4885 **Low cost radioiodine air sampling system for nuclear incidents: experience at Three Mile Island.** Distenfeld, C.; Klemish, J. (Brookhaven Natl Lab, Upton, NY). *USIEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) (U.S.);* **NS-27**: No. 1, 675-681(Feb 1980). (CONF-791037—).

From IEEE nuclear science/nuclear power systems symposium; San Francisco, CA, USA (17 Oct 1979).

An air mover was developed to draw 5 /plus or minus/ .5 ft/sup 3/ min/sup -/1 through a combined HEPA filter and absorber. The air mover can be operated on 110V alternating current or 12V direct current available from standard automotive electrical systems. Air mover cost was a major design consideration. The third (last) prototype was used to estimate production cost of 100 air movers. The overall unit cost for an air mover and a filter-canister assembly was between /157 and /107 in 1978 dollars. A 4% silver loaded silica gel adsorber was developed that would trap organic iodine, hypoiodous acid, and element iodine with better than 90% efficiency under severe ambient conditions, for a 5 minute collection cycle. The principal advantage of the 4% silver loaded silica-gel adsorber was low noble gas adsorption efficiency. Xenon adsorption efficiency was less than 5*10/sup -3%/ at 55/degree/C and 4*10/sup -2%/ at 7/degree/C. The last figure is about 200 times better than charcoal at the same temperatures. 14 refs.

4886 **Sensor for measurement of fuel rod gas pressure during loss-of-fluid-tests.** Billeter, T.R. (Hanford Eng Dev Lab, Richland, Wash). *USIEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) (U.S.);* **NS-27**: No. 1, 826-832(Feb 1980). (CONF-791037—).

From IEEE nuclear science/nuclear power systems symposium; San Francisco, CA, USA (17 Oct 1979).

Qualification tests have been conducted of a measurement system for determining the pressure of certain fuel rods in the loss-of-fluid-test (LOFT) reactor. Because of physical size (0.35-in. OD by 5.5-in. length) and operational characteristics, an eddy current device was selected as the most promising measurement transducer for the application. The sensor must operate at pressure up to 17.2 MPa (2500 psig) and at temperatures up to 800/degree/F. During the reactor transient caused by loss of coolant flow, sensor temperature and applied pressure will vary rapidly and significantly.

4887 **2200°C fuel centerline thermocouples for the LOFT program.** Cannon, C.P.; Lunghofer, J. (Hanford Eng Dev Lab, Richland, Wash). *USIEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) (U.S.);* **NS-27**: No. 1, 848-851(Feb 1980). (CONF-791037—).

From IEEE nuclear science/nuclear power systems symposium; San Francisco, CA, USA (17 Oct 1979).

Two types of thermocouples were developed and tested. Model B units contained a 1.6 mm (1/16-inch) O.D., 61 cm (24-inch) long Mo/Re sheath probe and were capable of temperature measurement to 1550/degree/C. Model A units contained 1.6 mm O.D., 104 cm long W/Re-augmented sheath probe and were capable of temperature measurement to 2220/degree/C. Both thermocouples were insulated with sintered HfO/sub 2/ insulators and contained W/5Re-W/26Re thermoelement wires. Both probe sheaths were terminated with an Al/sub 2/O/sub 3/ ceramic-to-metal seal capable of maintaining hermeticity to 10/sup -9/ cc He/s during temperature transients to 360/degree/C/min. at 7.2 MPa (2500 psi) continuous and pressure transients of 2.4 MPa (350 psi)/s at 450/degree/C continuous. The thermocouples operated for 1000 hours at their maximum operating temperatures of 2200/degree/C (model A) and 1550/degree/C (model B) with less than 2% drift in the EMF output. The thermocouples also survived thermal transients of up to 145/degree/C/s with no measurable degradation in measurement performance. 6 refs.

4888 **Operator/instrumentation interactions during the Three Mile Island incident.** Cummings, G.E. (Lawrence Livermore Lab, Calif). *USIEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) (U.S.);* **NS-27**: No. 1, 931-934(Feb 1980). (CONF-791037—).

From IEEE nuclear science/nuclear power systems symposium; San Francisco, CA, USA (17 Oct 1979).

A discussion is presented of the operator/instrumentation interactions which had an effect on the course of the incident at the Three Mile Island-2 Nuclear Power Plant. A brief review of the sequence of occurrences at TMI-2 over the first 16 hours of the incident is given with particular emphasis on operator/instrumentation interactions. A breakdown of the six major items that seemed to have contributed to the characteristics of the incident is then given and also an outline of some of the currently proposed operator/in-

strumentation improvements. The six major items involve water level indication in the reactor, electromatic relief valve operation, auxiliary feedwater flow indication, containment isolation, extended range instrumentation, and computer readout. 4 refs.

4889 **Development and testing of a physicochemical model for predicting progress of reaction swelling in breached LMFBR fuel and breeder elements.** Caputi, R.W.; Adamson, M.G.; Evans, S.K. pp 214-232 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

This study investigates from an analytical standpoint the problem of reaction of sodium with the mixed-oxide fuel following breach of the cladding and develops predictive correlations of swelling with time in breached fuel rods that will be helpful to those concerned with performance of breached driver fuel pins and blanket rods in an LMFBR and plant-related consequences. 5 figures.

4890 **Fuel/clad reactions in mixed oxide fuel pins.** Bagley, K.Q.; Batey, W.; Findaly, J.R.; Paris, R. pp 233-245 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Metallographic examination of mixed (U, Pu) oxide pins irradiated in DFR have demonstrated a generally consistent pattern of fuel/clad chemical interaction. The majority of pins normally show internal corrosion at temperatures above ~ 500°C which is exemplified by an outer layer of uniform matrix corrosion and an underlying zone of intergranular reaction. The dominant corrosion mechanism is judged to be a clad oxidation process in wich cesium and tellurium may play important roles. The incidence of this type of corrosion, the depths of penetration observed and the influence of pin design and irradiation parameters are summarized. Overall, UK experience has given confidence that fuel/cladding chemical interaction is not a major contributor to pin failure but one subassembly experiment, the Mk VIIa, proved an exception to the rule, showing a uniquely high failure rate after irradiation to 9% burnup. This experiment differed from most of its predecessors in that pins were longer, and were wire wrapped; additionally, the pins were of higher linear heat rating and larger diameter than the pins from all other sub-assemblies except one. Failures were observed to occur in the middle length of Mk VIIa pins, where clad temperatures range between 380 and 540°C, and were found to be associated with severe intergranular corrosion differing in character from the type seen in other pins. Microstructural features and chemical analysis data on the corrosion zone are detailed and preliminary hypotheses concerning the corrosion mechanism are described.

4891 **Fuel cladding mechanical interaction: observations and analysis.** Gatesoupe, J.P. (DMECN, Fontenay-aux-Roses, France); Guerin, Y.; Courtois, C.; Truffert, J. pp 246-257 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Fuel-cladding mechanical interactions (FCMI) seem to be a relatively minor problem in France, according to Phenix and Rapsodie experience. After a review of some experimental evidence of isolated FCMIs, a brief analysis is made of the reasons why deformations due to FCMIs are not observed. 2 figures. (DLC)

4892 **Behavior of particulate oxide fuel during simulated multiple overpower transients.** Bottcher, J.H.; Buzzell, J.A.; Hofman, G.L. (Argonne National Lab., IL). pp 320-326 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Behavior of the Vipac oxide fuel during simulated operation involving multiple overpower transients indicates that this form of fuel would be an excellent candidate for low power LMFBR transient overpower operation. The accomodation by the fuel of the fuel-cladding mechanical interaction during transients implies that the cladding loading will be insufficient to induce strain. The behavior of the Vipac fuel further suggests that Spherepac fuel may behave similarly. However, because of such differences as particle morphology and interparticle friction, DEH testing and evaluation of Spherepac fuel are recommended. 4 figures.

4893 **Behavior of irradiated UO_2 - PuO_2 under simulated cyclic overpower transients.** Hofman, G.L.; Bandyopadhyay, G.; Brown, F.L.; Buzzell, J.A. (Argonne national Lab., IL). pp 327-330 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The pellet fuel used in the described tests held up rather well when subjected to as many as eight transient cycles. The crack patterns were on the whole similar to those accrued during steady-state reactor operation, with the exception of some circumferential fracturing in the high-burnup samples. These fractures could result in spalling or chipping, but the fuel-cladding gap at higher burnups is expected to close to a large extent, thereby reducing the change of such chips to become wedged between pellet and cladding. Transient fuel swelling was found to be limited to about 5 to 6%, and this value was reached with only a few cycles. No effect of prior burnup was detectable. The magnitude of transient swelling observed is consistent with that found in a similar one-cycle test performed in TREAT on PNL1 fuel by Culley et al. This fuel was irradiated in EBR-II to a burnup of ~ 27 kW m^{-1} and taken in a 3 s transient to ~ 2500°C, after which it showed a 3.6% volume increase. However, the crack pattern in this fuel was very different. It is concluded that an oxide-fuel element of the nearly standard LMFBR type can be used as a transient driver-fuel element under conditions similar to those used in the described tests. The severity of the long transient used corresponds to reactivity insertions of about 0.20 \$ s^{-1}. If fuel melting is avoided, only a limited amount of swelling is to be expected even after repeated events.

4894 **Behavior of advanced carbide fuel during transient overpower operations.** Tsai, H.C.; Neimark, L.A.; Johnson, D.L. pp 853-862 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

A series of six transient overpower tests that simulated 50 cents/s Fast Test Reactor power ramps were performed on advanced helium- and sodium-bonded carbide fuel elements. The primary purpose of the tests was to demonstrate that these fuel types can perform acceptably during reactor-transient operations. The results obtained to the date demonstrate the adequacy of the transient-performance capabilities of the advanced-carbide fuel designs under the test conditions employed. 6 figures.

25 ENERGY STORAGE

4895 **New applications of polymers in energy storage systems.** Pezdirtz, G.F. (US DOE, Washington, DC). *USA-merican Chemical Society, Division of Organic Coatings and Plastics Chemistry, Papers (U.S.);* **42**: 249-256(1980). (CONF-800303—).

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

This paper presents brief descriptions of several RandD projects on the subject of energy storage systems. The emphasis is placed on progress in achieving desired engineering properties, and where appropriate, mention is made of the basic studies that are needed to provide greater insight into important phenomena and new options for developing polymers with greatly improved properties. The polymeric materials projects are described in order of the size of the effort, beginning with flywheel technology, which is the largest. 8 refs.

2502 Compressed Gas

4896 **(PNL—3429) Corrosion of well casings in compressed air energy storage environments.** Elmore, R.P.; Stottlemyre, J.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1980. Contract AC06-76RL01830. 34p. NTIS, PC A03/MF A01.

The goal of this study was to determine corrosive effects of compressed air energy storage (CAES) environments on several well casing materials to aid in material selections. A literature search on corrosion behavior of well casing material in similar environments revealed that corrosion rates of 0.20 to 0.25 mm/y might be expected. This information was employed in designing the laboratory study. Unstressed electrically isolate samples of various carbon steels were autoclaved at varying humidities, temperatures, and exposure durations to simulate anticipated environments in the well bore during CAES operation. All compressed air tests were run at 12.1 MPa. Temperatures varied from 323°K to 573°K, and humidity varied from 100% to completely dry air. The effects of salts in the humidified air were also studied. Results indicated that typical well casings of carbon steel as used in oil, gas, and water production wells adequately withstand the anticipated CAES reservoir environment. An acceptable corrosion rate arrived at by these laboratory simulations was between 0.0015 and 0.15 mm/y. Corrosion was caused by metal oxidation that formed a protective scale of iron oxide. Higher temperatures, humidity rates, or salinity content of the humid air increased corrosion. Corrosion also increased on a metal coupon in contact with a sandstone sample, possibly due to crevice corrosion. For each of these factors either singularly or collectively, the increased corrosion rates were still acceptable with the maximum measured at 0.15 mm/y. When coupons were reused in an identical test, the corrosion rates increased beyond the anticipated values that had been determined by extrapolation from one-time runs. Fine cracking of the protective scale probably occurred due to thermal variations, resulting in increased corrosion rates and a greater potential for particulates, which could plug the reservoir.

4897 **(PNL-SA—8998) Investigating air/water/rock interactions in CAES porous rock reservoir.** Stottlemyre, J.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 8p. NTIS, PC A02/MF A01.

FY-1980 laboratory tests on sandstones and well casing materials subjected to simulated Compressed Air Energy Storage (CAES) conditions are summarized. The objectives of this experimental program are: to generate and interpret data that can be used to select reservoirs and develop operating criteria, and assess environmental issues; and to develop equipment and procedures for site-specific field project support. Specific subtasks described herein cover well casing corrosion tests; sandstone permeability and mechanical stability tests with elevated-temperature dry air; similar tests with groundwater; and the development of strategy for future experiments in the porous-media flow facility currently undergoing acceptance testing.

4898 **(PNL-SA—9029) Numerical studies of compressed air energy storage caverns in hard rock.** Brandshaug, T.; Fossum, A.F. (RE/SPEC, Inc., Rapid City, SD (USA)). 1980. Contract AC06-76RL01830. 8p. NTIS, PC A02/MF A01.

A program to develop and use numerical models to evaluate the behavior of compensated CAES caverns in hard rock is summarized, and methodology for the development of stability criteria is established. It is concluded that there is adequate information available to enable a designer to design an underground opening with the size, shape, and depth required of a CAES cavern with regard to its excavation and construction, based on a combination of numerical modeling and precedent considerations. It is recommended that numerical methods be used in combination with in situ tests to permit the development of a design methodology for the operation of a CAES cavern.

4899 **(PNL-SA—9037) Reservoir stability studies.** Doherty, T.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 8p. NTIS, PC A02/MF A01.

The Reservoir Stability Studies project is the geotechnical component of the Compressed Air Energy Storage Technology Program at the Pacific Northwest Laboratory. Its purpose is to establish stability criteria for underground air storage reservoirs for CAES application in salt, hardrock and porous media geologies through applied research studies. This paper provides the overview and structure of that project and indicates 1980 progress with respect to program goals. Included is summary reporting on fluid thermal and thermomechanical modeling of porous media reservoirs.

2503 Pumped Hydro

REFER ALSO TO CITATION(S) 4624

2505 Flywheels

REFER ALSO TO CITATION(S) 5003

2506 Thermal

4900 **(ORNL/Sub—7604/2) Potential benefits of thermal energy storage in the proposed Twin Cities district heating-cogeneration system. Final report.** Meyer, C.F. (General Electric Co., Santa Barbara, CA (USA). Center for Advanced Studies). Oct 1979. Contract W-7405-ENG-26. 128p. NTIS, PC A07/MF A01.

A new, large, cogeneration-district heating system has been proposed for the Twin Cities area, using hot water in a closed-loop system. The proposed system, as described by Studsvik Energiteknik AB of Sweden, does not employ thermal energy storage (TES). Four cases have been developed, describing system configurations which would employ TES, to evaluate the potential benefits of incorporating annual-cycle TES into the Twin Cities system. The potential benefits are found to be substantial, confirming results of earlier, generic studies of aquifer TES. The reference (Studsvik) system employs oil-fired boilers to supplement cogenerated heat, for handling peak loads and providing standby reserve. TES can serve the same function, with net energy savings in spite of heat losses during storage, by making it possible to operate the cogeneration equipment at higher capacity factors. Coal replaces oil as the fuel consumed. Energy savings of the reference system are impressive; energy savings with TES are 2 to 22% better. Capital cost requirements for boilers, cogeneration equipment, and pipelines are reduced by $66 to $258 million. The breakeven capital cost of TES is estimated to range from $43 to $76 per kilowatt peak thermal input to or withdrawal from aquifer TES. A factor in evaluating the breakeven operating cost of TES is the $14 to $31 million per year saving in cost of fuel. Abatement of air pollution and thermal pollution are concomitant benefits.

2509 Batteries

REFER ALSO TO CITATION(S) 5003, 5037

4901 (DOE/ET/29345—21) Development of zinc-bromine batteries for utility energy storage. First annual report, 1 September 1978-31 August 1979. Putt, R.; Attia, A.J.; Lu, P.Y.; Heyland, J.H. (Gould, Inc., Rolling Meadows, IL (USA). Gould Labs.). May 1980. Contract AC02-78ET29345. 132p. NTIS, PC A07/MF A01.

Development work on the Zn/Br battery is reported. A major improvement was the use of a bipolar cell design; this design is superior with respect to cost, performance, and simplicity. A cost and design study for an 80-kWh module resulted in a cost estimate of $54/kWh(1979$) for purchased materials and components, on the basis of 2500 MWh of annual production. A cell submodule (nominal 2 kWh) of full-sized electrodes (1 ft^2) accrued over 200 continuous cycles in a hands-off, automatic routine with efficiencies in the range of 53 to 56%. Initial testing of a full-sized 8-kWh submodule demonstrated energy efficiencies of 65 to 67%. 23 figures, 10 tables. (RWR)

4902 (DOE/RA/26961—01) Evaluation of battery converters based on 4.8-MW fuel cell demonstrator inverter. Final report. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Oct 1980. Contract AC01-76ET26961. 184p. NTIS, PC A09/MF A01.

Electrical power conditioning is a critical element in the development of advanced electrochemical energy storage systems. This program evaluates the use of existing self-commutated converter technology (as developed by the Power Systems Division of United Technologies for the 4.8-MW Fuel Cell Demonstrator) with modification for use in battery energy storage systems. The program consists of three parts: evaluation of the cost and performance of a self-commutated converter modified to maintain production commonality between battery and fuel cell power conditioners, demonstration of the principal characteristics required for the battery application in MW-scale hardware, and investigation of the technical requirements of operation isolated from the utility system. A power-conditioning system consisting of a self-commutated converter augmented with a phase-controlled rectifier was selected and a preliminary design, prepared. A principal factor in this selection was production commonality with the fuel cell inverter system. Additional types of augmentation, and the use of a self-commutated converter system without augmentation, were also considered. A survey of advanced battery manufacturers was used to establish the dc interface characteristics. The principal characteristics of self-commutated converter operation required for battery application were demonstrated with the aid of an available 0.5-MW development system. A survey of five REA and municipal utilities and three A and E firms was conducted to determine technical requirements for operation in a mode isolated from the utility. Definitive requirements for this application were not established because of the limited scope of this study. 63 figures, 37 tables.

4903 (STU—78-4981) Silver-iron batteries. Lindstroem, O. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Apr 1980. 52p. (In Swedish). NTIS, PC A04/MF A01.

Production methods for iron electrodes have been studied. It was found that a sintering temperature of 700°C gave the best strength and capacity. Production methods and additions for silver electrodes have also been studied. The capacity of the produced iron and silver electrodes were 1100 mAh/cm3. Different separators have been investigated. Cellophane I and II from Du Pont was found to be the best. In tests open cells have achieved 60% of the calculated capacity. In order to minimize the increase of the pressure in closed cells different additions to the electrodes have been studied. Raney-Palladium have been produced and used as a catalyst for hydrogen recombination. When metal hydrides were added to the cell, the pressure increase was minimized within a certain limit. 23 figures.

4904 Hydrogen-bromine cell for energy storage applications. Yeo, R.S.; Chin, D.T. (Brookhaven Natl Lab, Upton, NY). *USJournal of the Electrochemical Society (U.S.);* **127**: No. 3, 549-555(Mar 1980).

An experimental and theoretical study has been made to determine the feasibility of a hydrogen-bromine cell for energy storage applications. The laboratory data were collected for the cell performance and the membrane characteristics during the charge and the discharge operations. An unsteady-state heat balance was used to predict the temperature change and the overall electric-to-electric efficiency. The results indicate that the hydrogen-bromine system can achieve an efficiency greater than 70% when the operating cell current density is less than 160 mA/cm/sup 2/. This work is pertinent to load-leveling applications.

4905 Battery Energy Storage Test (BEST) facility: test programs and data processing--an update. Hyman, E.A.; Pivec, A. (Public Serv Electr and Gas Co, Newark, NJ). *USProceedings, Intersociety Energy Conversion Engineering Conference (U.S.);* **1**: No. 79CH1477-9, 676-682(1979). (CONF-790803—).

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

The Battery Energy Storage Test (BEST) Facility is a Department of Energy (DOE), Electric Power Research Institute (EPRI) and Public Service Electric and Gas Co. (PSEandG) cofounded facility serving technology developers, electric utilities and the project sponsors in their mutual desire to commercialize effective battery energy storage technologies. A set of Test Program Guidelines is now under development at PSEandG with advice from user groups representing utilities and developers. Highlights of proposed guidelines for development, prototype and mini-demonstration test services are presented. 7 refs.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

4906 (BNL—28412) Consistent methodology for technology and policy impact assessment. Beller, M. (Brookhaven National Lab., Upton, NY (USA)). Oct 1980. Contract AC02-76CH00016. 19p. (CONF-801137—1). NTIS, PC A02/MF A01.

From Workshop on energy policy analysis; Urbino, Italy (3 Nov 1980).

A Reference Energy System is a useful tool for providing a baseline for energy technology and policy analysis. The technique of developing a Reference Energy System is described, and its use in various analyses is outlined.

4907 (ORNL/TM—7245) Interim report on nodel evaluation methodology and the evaluation of LEAP. Alsmiller, R.G. Jr.; Barish, J.; Bjornstad, D. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 223p. NTIS, PC A10/MF A01.

This report describes progress made at ORNL toward development and demonstration of a methodology for evaluating energy-economic modeling codes and important results derived from these codes. To bolster traditional evaluation methods with more-quantitative procedures of interest to the Energy Information Administration, ORNL is applying sensitivity theory as part of a comprehensive effort to quantify the importance of various data and model parameters to the key results that are of interest. The Long-Term Energy Analysis Program (LEAP) was chosen as the initial focus for the research. LEAP is an energy-economy model which resides in the Long-Term Energy Analysis Division (LTEAD) of the Integrative Analysis Group in the Office of Applied Analysis, EIA. LTEAD developed Model 22C of LEAP for two reasons: (1) to prepare projections through the year 2020, which were needed for the 1978 EIA Annual Report to Congress and (2) to develop a base for analyses of specific options for Federal action. LEAP Model 22C and its uses are described to provide the background for this interim description of the model evaluation effort at ORNL. 19 figures, 10 tables.

4908 Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980). 606p. (CONF-790852—). $60.00.

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

A separate abstract was prepared for each of the 44 papers and the keynote address for the Energy Data Base (EDB) and Energy Abstracts for Policy Analysis (EAPA); 21 of the abstracts will appear in Energy Research Abstracts (ERA). Two papers were processed earlier.

4909 **Limits to energy modeling.** Weinberg, A.M. (Oak Ridge Associated Universities, TN). pp 23-33 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

In his discussion on the limits to energy modeling, Dr. Weinberg supposes that the most obvious limitation is its incompleteness. He emphasizes a particular incompleteness that pervades not only energy modeling, but also energy policy itself - this is the trade-off between time and energy. Two sources of uncertainty are examined. These are uncertainty in parameters and intrinsic indeterminacy, either because of the mathematical structure of the system or because of the underlying intractability of the world that is to be modeled. He then examines the possibility that energy policy is a hopeless undertaking. He does not think so since we can do a great deal toward charting future courses that are based on propositions that are decidable. Two propositions about the breeder reactor are considered to illustrate the issue: it is not known how much uranium there is nor what future energy demand will be, and therefore it is not known when the breeder will be needed; and it is not known what the breeding ratio or the cost of a developed breeder will be. He concludes that the systematic examination of alternatives gives analysts valuable insights as well as places plausible limits on the consequences of actions, and these can be conveyed to policy-makers. The feasibility of the breeder reactor is certainly decidable, he concluded. (MCW)

4910 **Six bridges between the builders and users of energy models.** Peck, S.C. (Electric Power Research Inst., Palo Alto, CA). pp 41-62 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

The EPRI Systems Program conducts a research program on energy R and D planning and utility decision making. The program focuses on the analysis of specific issues, on model development, and on model assessment. This paper describes efforts to build bridges between modelers and decision makers. The examples are taken from work which the Systems Program has funded or from in-house research. The examples include the Energy Modeling Forum at Stanford; the Model Assessment Laboratory at MIT; the use of transfer projects which form teams of model builders and users to study questions; the importance of providing decision makers with explanations of complex model results by means of simple heuristic models; the reporting of many scenarios so as to sturcture and support protagonists from both sides of a debate; the use of decision analysis as a communication tool.

4911 **Improving model specificity or the decision maker as a consumer: linking the policy decision maker to model results.** Forrester, P.J. (Massachusetts Office of Energy Resources, Boston, MA). pp 235-244 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

Mathematical forecasting models as a process of representing a complete system by a simpler process have some well-known limitations, of which the better understood are (1) reliance on historical or cross-sectional data, (2) estimating future behavioral relationships, and (3) misperceptions of results based upon the mathematical precision of model output. However, to a greater degree, the problem with mathematical modeling (which is only confounded by the above factors) is the policy decision makers are not very good consumers of models, their limitations, or advantages. As a result, models too often become mathematical briefs for particular philosophies or points of view. Instead of concerning themselves with the north-south estimations that many well-conceived and -constructed energy models are capable of delivering, there is a procrustean concern on the part of model critics, proponents, and vicariously, regulatory decision makers, to judge the credibility of model forecasts on point-estimation validation. This is an especially serious problem in modeling energy futures and is, in large measure, directly responsible for the lack of policy based on modeling at all levels of government. This paper presents a simple cost (risk)/benefit approach to reconciling the problem of adding credibility to model output through increased spending on data and model development versus the less-expensive but institutionally tougher job of improving the decision maker as a consumer and the environment in which important and risky decisions are made.

4912 **Energy-modeling activities at the Office of Technology Assessment.** Rowberg, R.E.; Hollomon, J.B.; Thoreson, R. (Congress, Washington, DC). pp 363-369 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

The OTA is first described, then the role that models play in activities at the agency is examined. An outline of its philosophy of using models is presented. Models are used conservatively in OTA's approach in that it does not use them as predictors of what will happen, but rather as a way to bound the range of possibilities subject to a highly specified set of conditions. Examples are presented of model use to show why the Energy Group at the OTA is cautious about use of models. OTA believes that the responsibility for wise use lies at least as much with users as model builders. Until users can come to some consensus about such things as price forecasts and discount rates even the best models will be limited in their use. (MCW)

4913 **Electricity demand modeling as an input to NRC licensing decisions: a case study of model evolution.** Dick, J.W.; Kaserman, D.L. (Oak Ridge National Lab., TN). pp 401-413 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

Traditionally, the central focus of economic analysis within the Nuclear Regulatory Commission's (NRC) licensing procedures has been on evaluating the need for the proposed facility. To a large extent, this analysis has been based on forecasting demand for electricity within the relevant service territory. The ORNL State Level Electricity Demand (SLED) forecasting model has been developed, through grants from the NRC, specifically for this purpose. This paper focuses on this model in a case study of the process which has influenced model development, refinement, and use over time. First, the relevant part of NRC licensing procedures and two alternative methodologies for capacity-expansion decision making are discussed. This discussion points out the need for electricity-demand forecasts. Then some special needs and problems associated with these forecasts are examined. Finally, the development of the ORNL SLED model is examined. The roles of the policy makers, modelers, and the third party who applies the model are discussed. Emphasis is placed on the interactions of these groups and also on the length and quality of the relationships between the modelers and the policy makers.

4914 **Sailing and the art of energy trend analysis.** Woods, T.J. (General Accounting Office, Washington, DC). pp 415-424 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

The General Accounting Office is analyzing the long-term trends in US energy supply and demand to provide itself an institutional framework within which to assess US energy issues, policies, and programs. This analysis progressively disaggregates the energy system on a physical/engineering basis to identify the major factors that drive the trends. Economic and institutional factors are only introduced after the broad mechanical/engineering relations are worked out. This method allows the user to choose the degree of detail he wishes and to understand the constraints within which policy initiatives must function. It also can provide a basis within which to identify potential discontinuities in energy trends which are the points at which future policies must be focused. Lastly, its phenomenological roots and hierarchical structure allow a non-technically-versed user to better understand and discuss the results of the analysis. Results of the analysis of the long-term trends in US petroleum production are presented. These trends indicate that price will not be the major determining factor in future petroleum production. The major overall determinant will be the extent of indicated and inferred petroleum reserves, not the undiscovered recoverable resource base.

4915 **Sensitivity analysis for energy-economy modeling.** Oblow, E.M.; Weisbin, C.R.; Alsmiller, R.G. Jr. (Oak Ridge National Lab., TN). pp 425-435 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

Two methods (i.e., screening designs and adjoint theory) for determining sensitivity coefficients for large-data-base energy-modeling code systems are discussed in detail. The two methods form the basis for a model validation effort on the LEAP long-range energy modeling code used by DOE. The advantage of a screening design for short-term sensitivity studies and its disadvantage in terms of cost are discussed. The long-term cost/benefit of the adjoint approach and its disadvantage in requiring development work are also covered. The theroy behind both methods and how they might be applied in a validation program are described in some detail.

4916 **Real-world non-interface between the model builder and the decision maker.** Plummer, J.L. (Electric Power Research Inst., Palo Alto, CA). pp 525-529 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

Model builders desperately want more interface with decision makers. It is usually presumed that it is possible and desirable for model builders to push for more hours of direct interface with decision makers. This paper lays out the opposing point of view. It is contended that there are compelling political reasons why the decision maker doesn't want more interface, and why a push for greater interface by the model builder may well heighten the nervousness of the decision maker and result in less interface. The role of the intermediary model user is a specialized efficient function that should be respected rather than resented by the model builder. The role of intermediary model user is evolving further into the even more detached (and thus potentially efficient) role of energy-model broker.

4917 **Keynote address.** Dingell, J.D. (Congress, Washington, DC). pp 587-596 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

Honorable John D. Dingell, US Congressman from Michigan, in his keynote address, says the legislative branch of the government is remarkably lacking in the appreciation of the skills and services which are available from mathematical modelers. He then discusses how the government decision making process not only uses but could and should use the skills of energy modelers. The public interest in seeing that mathematical modeling is properly used by the government is also examined. He then pointed out directions that model builders should take to improve the process of informing decision makers not only on what can be done to help them but to inform them better how they can best use the talents, skills, and the input that they can bring the decision making process. (MCO)

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 4907, 4915, 4931, 4936, 4969, 5321

4918 **Use and misuse of energy models in tax legislation.** Wetzler, J.W. (US Congress, Washington, DC). pp 289-297 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

The paper describes the use of quantitative energy models by the tax-writing committees of Congress in three major energy tax bills: The Energy Conservation and Conversion Bill of 1975; the Energy Tax Act of 1978; and the Crude Oil Windfall Profit Tax Act of 1979. This history is used to draw conclusions about what characteristics of energy models make them most useful to Congress.

2903 Environment, Health, And Safety

4919 **Integrated energy/environmental modeling for policy analysis.** Hartzler, R.E.; Rebibo, K.K. (The MITRE Corp., McLean, VA). pp 463-473 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

A family of energy/economic/environmental models is presented as a mechanism for analyzing national policy issues. These models include FOSSIL1, a dynamic national energy model, the Strategic Environmental Assessment System (SEAS) which computes national and regional economic and environmental impacts of energy policies, and SPURR, a solar market penetration model. The models are used interactively to project future energy supply mixes and to determine the economic and environmental implications of these mixes in evaluating impacts of a broad range of energy and environmental policy issues. The nature of the linkage and feedbacks between the models is presented and the energy, environmental, and economic information flows among them are discussed. Examples are given of the types of policy issues which can be addressed using these linked models.

2904 Natural Resources

4920 **(CONF-801158—1) Comments on long-term aspects of renewable vs nonrenewable resource substitution.** Goeller, H.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01.

From Interciencia workshop on materials for the future; Kingston, Jamaica (17 Nov 1980).

There are many cases where materials applications involve the use of nonrenewable materials. In some instances, renewable resources can be substituted for nonrenewable ones; in other cases, there are no readily feasible renewable-resource substitutes for certain nonrenewable-materials applications. The author points out advantages and limitations of renewable resources as substitutes for nonrenewale resources, with particular emphasis on the longer term when economic resources of some of the more-limited chemical elements will be starting to run out or will, or least, become too expensive to use except in absolutely necessary, nonsubstitutable uses. On the one hand, renewable resources will continue to become available through natural processes, in some cases augmented by modern technology, but only at some maximum level. For example, the amount of hydroelectric power available in the world is deter-

mined by rainfall and topography. On the other hand, nonrenewable resources are generally regarded as being material souces that, once used, are gone forever. This is certainly true for fossil fuels, where current demands are many orders of magnitude larger than rates of formation of new coal and petroleum. It is not true, however, for some of the atmospheric gases (e.g., nitrogen and argon) which are returned to the atmosphere either directly or through biological processes after use use so that they are truly renewable resources.

4921 **(LA-UR—80-3342) Energy, helium, and the future: II.** Krupka, M.C.; Hammel, E.F. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 23p. (CONF-801210—6). NTIS, PC A02/MF A01.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

The importance of helium as a critical resource material has been recognized specifically by the scientific community and more generally by the 1960 Congressional mandate to institute a long-range conservation program. A major study mandated by the Energy Reorganization Act of 1974 resulted in the publication in 1975 of the document, The Energy-Related Applications of Helium, ERDA-13. This document contained a comprehensive review and analysis relating to helium resources and present and future supply/demand relationships with particular emphasis upon those helium-dependent energy-related technologies projected to be implemented in the post-2000 year time period, e.g., fusion. An updated overview of the helium situation as it exists today is presented. Since publication of ERDA-13, important changes in the data base underlying that document have occurred. The data have since been reexamined, revised, and new information included. Potential supplies of helium from both conventional and unconventional natural gas resources, projected supply/demand relationships to the year 2030 based upon a given power-generation scenario, projected helium demand for specific energy-related technologies, and the supply options (national and international) available to meet that demand are discussed. An updated review will be given of the energy requirements for the extraction of helium from natural gas as they relate to the concentration of helium. A discussion is given concerning the technical and economic feasibility of several methods available both now and conceptually possible, to extract helium from helium-lean natural gas, the atmosphere, and outer space. Finally, a brief review is given of the 1980 Congressional activities with respect to the introduction and possible passage of new helium conservation legislation.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 4912

4922 **(THE—7-1980) Community without oil. A report on technical R and D to support our ability to provide energy.** Luthman, G.; Lagermalm, G. (Tekniska Hoegskolornas Energiarbetsgrupp, Stockholm (Sweden)). 1980. 110p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01.

The report gives a review of the energy use and energy related activities in Sweden, tries to evaluate the possible impacts of new energy technology under development, and identifies areas where more R and D are needed and makes suggestions for research programs.

4923 **Technical books and monographs. 1979 compilation.** Oak Ridge, TN; Technical Information Center (1980). 33p. (DOE/TIC—4582-R13S1). TIC.

This booklet lists technical books and monographs published since the issuance of Technical Books and Monographs, 1978 Catalog, a bibliography of books and monographs sponsored by the US Department of Energy (DOE) or by one of the earlier organizations that were brought together to form DOE. In general, information for each published book, and for each book in press when known, includes title, author and author affiliation, publisher and publication date, page count, size of book, price, availability information if the book is not available from the publisher, Library of Congress card number, International Standard Book Number (ISBN), a brief descriptive statement concerning the book, and a list or a description of the contents. The books and monographs are grouped under twelve subject categories: general reference, biology and medicine, chemistry, computers and mathematics, energy, engineering and instrumentation, environment, health and safety, isotope separation, metallurgy and materials, physics, and reactors. (RWR)

4924 **Research and development.** Abbott, J.A. (Shell Internationale Petroleum Mij., Den Haag, Netherlands). pp 256-260 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

Consideration of the effective use of petroleum affords a clear challenge to provide for those demands made by society upon the use of petroleum as a natural resource. Those demands are, of course, immediately conflicting; namely, to use petroleum as chemicals feedstock or as fuel. Each sector of industry concerned with the production and use of petroleum products has a contribution to make in improving its effective use via research and development. These contributions range from enhancing the yield of crude oil and gas from producing fields and improving methods of energy management to making better use of petroleum products in relation to fuel and energy. This latter aspect covers not only the efficient combustion of hydrocarbon fuels but also their replacement by alternative fuels or alternative energy sources.

2906 Nuclear Energy

4925 **Evaluating nuclear utilities' performance: Nuclear Regulatory Commission oversight. Twenty-eighth report presented before the US House of Representatives, Ninety-sixth Congress, 2nd session.** Washington, DC; Committee on Government Operations (1980). 66p. GPO.

The House Environment, Energy, and Natural Resources Subcommittee examined the standards and criteria for licensing nuclear reactors and the reports on how the Three Mile Island accident was handled and investigated. Poor managerial performance is cited for both utility construction and operation under the present Nuclear Regulatory Commission (NRC) license criteria. Recognizing the problem, the NRC is initiating new programs to correct these deficiencies with better staffing, interagency cooperation, and upgraded personnel. The crucial need, however, is aggressive enforcement action on NRC regulations. Recommendations to the NRC to raise its monitoring and enforcement performance are aimed at identifying weak utilities, increasing regional cooperation, and evaluating license applications. 199 references.

4926 **(ORAU/IEA—80-11(P)) Acceptable nuclear futures: the second ERA.** Firebaugh, M.W. (ed.). (Institute for Energy Analysis, Oak Ridge, TN (USA)). 1980. Contract AC05-76OR00033. 74p. (CONF-8005113—). NTIS, PC A04/MF A01.

From Workshop on acceptable nuclear futures: the second era; Oak Ridge, TN, USA (28 May 1980).

This workshop brought together some of the most prominent early workers in the field of nuclear energy to examine the state of the art and to suggest directions and criteria for designing an acceptable future nuclear-energy system. Topics of discussion ranged from the technical characteristics of present and future reactor systems to the institutional issues of energy need, electrical substitution, alternative nuclear applications, and safety implications. As is frequently the case with such conferences, it was easier to identify problems with the present system than to agree on proposed routes to a second nuclear era. The range of opinions expressed at the workshop was too broad to permit the development of a simple concensus. In these edited proceedings the attempt is made to reconstruct the essence of the exchanges.

4927 **(PNL—3159) Nuclear energy information flow from DOE to the public.** Simmons, J.L.; Rankin, W.L.; Nealey, S.M. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Jun 1980. Contract AC06-76RL01830. 43p. (B-HARC—411/014). NTIS, PC A03/MF A01.

The objective of this research was to study the DOE's program for educating the public about nuclear power and nuclear waste management. DOE's organizational structuree and the procedures used within this structure to disseminate information were studied and readability tests on nuclear information distributed by DOE were conducted. Initial information was obtained through interviews with 29 local, state, and federal DOE representatives. This was supplemented with additional information as it was released by the DOE. The primary goals of the DOE's information program are to encourage two-way communication between the DOE and the public and to encourage public participation in policy-making decisions. Most of this communication, however, is presented orally. Relative to other energy technologies and conservation, very few nuclear brochures are currently being distributed by the DOE. This is especially true with regard to information about nuclear waste. A recent public survey found that a majority of the public wants to learn more about nuclear power and that, with regard to the nuclear fuel cycle, the public wants most to learn about nuclear waste management. Thus, the DOE appears to be missing an eager audience.

4928 **Carter nuclear-licensing reform versus Three Mile Island.** Sylves, R.T. *USPublius. The Journal of Federalism (U.S.);* **10**: No. 1, 69-79(Win 1980).

The accident at Three Mile Island and the events following it modified nuclear power plant licensing procedures and incrased the state role in the siting and licensing processes to some extent, but administrative changes will be limited until legislation such as the proposed Nuclear Siting and Licensing Act (NSLA) can be passed. Until the concept of shared responsibilites contained in NSLA can be enacted, Federal and state activities will continue to overlap and often contradict, with utilities conforming to the regulations of both. By making the two levels of regulation interdependent, the proposed legislation coordinates responsibilities and eliminates unnecessary duplication. In the meantime, state nuclear regulatory actions will continue to operate outside a common framework and will make it more difficult for utilities to choose the nuclear option. 40 references. (DCK)

2907 Transport And Storage

REFER ALSO TO CITATION(S) 4501, 4995

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 4900, 5012, 5013

4929 **(CISE—1606) Optimized design of total energy sytems: the RETE project.** Alia, P.; Dallavalle, F.; de Nard, C.; Sanson, F.; Veneziani, S.; Spagni, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). 1980. 40p. (CONF-8005120—1). NTIS, PC A03/MF A01.

From 4. international conference of urban heating; Sirmione, Italy (12 May 1980).

The Total Energy Systems can be defined, at a conceptual level, as systems meeting the energy requirements of a user by maximizing the utilization of primary energy sources (with reference to their thermal-dynamic quality) and, as a consequence, by minimizing the consumption of nonrenewable energy sources. The RETE (Reggio Emilia Total Energy) project has been conceived as a demonstration plant of the TES concept. The study was developed at CISE to: achieve the maximum quality matching on the thermal energy side, between plant and user and perform an open scheme on the electrical-energy side by connection with the Italian electrical network. The most-significant qualitative considerations at the basis of the plant economic-energy optimization and the selection of the operating criterion mostly fitting the user-consumption characteristics and the external system constraints are reported. The design methodology described results in a TES that: in energy terms achieves a total efficiency evaluated on a yearly basis to be equal to about 78% and a fuel saving of about 28% and in economic terms allows a recovery of the investment required as to conventional solutions, in about 7 years.

4930 **(TRITA—37) Steam systems for large heat effects and long distances.** Rydberg, J. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Uppvaermnings- och Ventilationsteknik). 1980. 28p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01.

In Sweden hot water culverts are used for the distribution of heat in district heating systems. When big quantities of heat are to be transported, e.g., between two towns, it is considered to be economic to use steam instead of hot water. In a hot water system two big hot water pipes are needed. In a steam system only one pipe of the same dimension as the pipes in the hot water system is needed and another pipe for the returning condensate with a diameter of 30% of the diameter of the steam pipe. In a water system there also has to be a pumping station on every 10 to 20 km. The steam can be transported by its own expansion 100 to 150 km. The energy consumption for the transportation in a steam system is only half of what it is needed in a hot water system. The pump stations for the condensate need not be as big as the ones for the hot water system because only 1/10 of the amount of water is circulated. Consequently, for long distances, both investment costs and operation costs gets cheaper with a steam system.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 4520, 4907, 4911, 4914, 4920, 4922, 4941, 4946

4931 **Information requirements for a regional energy model: the Hawaii experience.** Joun, R.Y.P. (State of Hawaii, Honolulu). pp 207-224 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

The information needed to construct a model of regional energy demand and supply is described, based on the experience of the modeling efforts in Hawaii. Most of the national energy models do not adequately deal with the energy problems unique to a region. A successful regional model, therefore, must delineate the precise nature of problems which regional planners must resolve. Once the objectives of regional energy planning are specified, regional energy models could help decision makers in obtaining information necessary to reach optimal decisions. The paper discusses the structure of the Hawaii energy-economic models which are currently being constructed to analyze the energy-planning problems in Hawaii. Decision makers in Hawaii need information necessary to develop alternatives and strategies for developing Hawaii's abundant indigenous energy resources (geothermal, biomass, solar, wind, and ocean thermal energy conversion). Information necessary to construct such models is then presented. Four models constructed to analyze the energy-resource developments in Hawaii are: economic; energy demand; energy supply; and a model of energy-intensive industries which might be located in the future in Hawaii. The general methodology utilized in constructing Hawaii energy-economic models could be applicable to other regional models although the Hawaii energy models are constructed to analyze the energy-planning problems in Hawaii.

4932 **Energy modeling experience in Alberta.** Quon, D. (Univ. of Alberta, Edmonton); McConaghy, D.J. pp 245-254 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

The Province of Alberta contains roughly three-quarters of Canada's currently established reserves of hydrocarbon fossil fuels. This predominant position has caused Albertan energy policy to be concerned primarily with supply, price, and economic-rent-allocation issues. These particular interests of Alberta have largely guided the form and scope of a 3-year energy modeling effort carried out by the Alberta Research Council. The current model is a dynamic, normative, demand-driven linear program capable of making allocative choices between different Albertan resources as they would be

used to meet overall Canadian energy needs, subject to certain policy constraints, over the 1980 to 2000 time frame. Extensive efforts were undertaken to make both governments and the energy industry aware of the capability and potential value of this model to their overall energy-planning analysis. This paper reviews the reaction that ensued. A proposal, resulting from these efforts, for using the Alberta Research Council supply model in conjunction with existing energy demand forecasting models with direct industry and government participation is described. Various institutional capabilities and limitations for the wider use of energy modeling and technical analysis in Canada are also discussed based on the Alberta experience to date.

4933 **World energy projections and some implications for energy policy.** Hirshfeld, D.S. (Ketron, Inc., Arlington, VA); Rapoport, L.A. pp 563-586 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

This paper presents some of the preliminary results of a series of model studies sponsored by the Department of State, DOE, and other agencies. The study forecasts and analyzes the long-range impacts of OPEC prices on worldwide energy supplies. The paper begins with a brief review of the modeling aproach and of the key input parameters and assumptions. Then, it sets forth a basic projection of world-wide energy-supply patterns to the year 2000 for a reference scenario corresponding to constant (real) OPEC prices. These forecasts provide a basis for examining the changes in energy supply (and consumption) patterns induced by a continuing increase in OPEC prices (e.g., 7.5% per year in a hihg-price scenario). Finally, some of the principal policy implications of these energy supply projections are outlined.

4934 **Energy supply and use when oil and gas becomes scarce.** Clarke, F.J.P. (United Kingdom Atomic Energy Authority, Harwell, England). pp 22-28 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

Alternative energy sources when oil and gas become scarce are chiefly coal and uranium, and on a lesser scale, renewable energy such as, wind power, geothermal energy, solar energy, wave power and tidal energy. Future total demand for primary energy can be provided with existing, developed and new coal technologies and nuclear power. One of the objectives of the research and development program will be to provide the technologies that can produce supplies at the lowest cost. Renewable energy sources may economically supplement the more conventional sources, but the extent of the economic contribution is still unknown. However, energy supply is only one part of the problem. What really matters is the cost of using energy to provide the needs of society. As oil and natural gas have to be replaced, there is likely to be an increasing trend towards the more expensive forms of energy. The higher cost of energy will stimulate energy conservation, but it is possible that even allowing for substantial savings from energy conservation, the proportion of the country's resources employed on energy supply could increase from the present level of just over 10%. Many options are present to meet the high cost of transport fuels and electricity. In the final analysis, the problem is not one simply of having adequate total energy supplies, but one of matching available supplies to appropriate end uses.

2930 Policy, Legislation, And Regulation

4935 **(P—800-80-009) Reimbursement guidelines and instructions for local agencies.** (California Energy Commission, Sacramento (USA)). May 1980. 18p. California Energy Commission, Sacramento, CA.

These guidelines provide forms and instructions to a local agency which is applying for reimbursement for the added costs it actually incurs in complying with the California Energy Commission's information requests during a power-plant-siting proceeding. Reimbursement of local agencies is authorized by Section 25538 of the Public Resources Code (PRC). It directs the Commission to reimburse the agency for such added costs that shall actually be incurred by the local agency in complying with the Commission's requests for comments and recommendations. The Commission, in turn, may request reimbursement from the person proposing the project. The Warren-Alquist Act grants to the Energy Commission the exclusive authority to certify all proposed thermal power plant sites and related facilities in the state. Provisions of the Act are discussed.

4936 **Optimal information selection under conditions of uncertainty: an example.** Goettle, R.J. IV; Hudson, E.A.; Jorgenson, D.W.; Lukachinski, J. (Dale W. Jorgenson Associates, Cambridge, MA). pp 305-332 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

The design and evaluation of energy policy must be predicated on an analytical and informational base. In a recent study conducted for the US DOE, two analytical systems - the integrated Brookhaven National Laboratory/Dale W. Jorgenson Associates (BNL/DJA) model system and the Data Resources, Incorporated (DRI) macroeconomic model - were used to analyze three energy price/policy futures. The focus of the analysis was the relationship between variations in energy prices and the performance of the US economy. Systematic differences were revealed in the informational products of the two models, with the BNL/DJA system estimating a larger economic impact. These differences reflect one aspect of the uncertainty surrounding the choice of an information base. Since it is uncertain which, if either, of the models is correct, the use of one entails the risk that policy guided by it will be predicated on inaccurate information. This risk is analyzed within an explicit framework and conditional, optimal selection strategies are formulated that minimize the expected damage resulting from the use of incorrect information. In selecting between alternative methodologies employed to address a specific policy issue, both the probability of a particular model being correct and the consequences of using that model when it is, in fact, wrong should be considered.

4937 **Role of the Energy Information Administration (EIA) in policy analysis.** Glassey, C.R.; Montgomery, W.D. (Dept. of Energy, Washington, DC). pp 351-362 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

This paper describes the Energy Information Administration (EIA), a branch of DOE, as a quasi-independent agency established by Congress to collect, analyze, and publish unbiased information. It discusses the difficulties inherent in performing objective analysis without advocating or designing policies, yet effectively contributing to the public-policy process. To illustrate this point, the paper describes how EIA analyzed regulations which the Economic Regulatory Agency (ERA) issued to implement the Power Plant and Industrial Fuel Use Act. Five principles are suggested, as guidelines, to show how objective analysis can contribute to policy design.

4938 **Modeling in the Federal regulatory process.** Moriarty, J.E. pp 371-400 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

Analyzing data as part of the Federal regulatory process presents some unique problems and requirements. This paper examines some of the legislative, organizational, and procedural factors which affect the techniques used in data analysis within the Federal Energy Regulatory Commission. Included is an analysis performed by FERC in support of policy formulation. Recent legislation, such as the Natural Gas Policy Act of 1978, has imposed new responsibilities on FERC. Some of the salient features of the Act, and how they have impacted the regulatory process, are discussed. The natural gas curtailment process is used to illustrate how analysis tech-

niques may be used to provide objective data for use in decision making. The sample analysis is a study of how severe weather conditions might affect high-priority natural gas customers. This study was selected because it exemplifies how analytical models may be used to support regulatory policy making necessitated by new legislative directives.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 4469, 4490, 4501, 4507, 4518, 4519, 4520, 4521, 4544, 4914, 4924

4939 (DOE/PE/70143—02(Vol.2)) FOSSIL2 energy policy model documentation: FOSSIL2 documentation. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Oct 1980. Contract AC01-79PE70143. 190p. NTIS, PC A09/MF A01.

This report discusses the structure, derivations, assumptions, and mathematical formulation of the FOSSIL2 model. Each major facet of the model - supply/demand interactions, industry financing, and production - has been designed to parallel closely the actual cause/effect relationships determining the behavior of the United States energy system. The data base for the FOSSIL2 program is large, as is appropriate for a system dynamics simulation model. When possible, all data were obtained from sources well known to experts in the energy field. Cost and resource estimates are based on DOE data whenever possible. This report presents the FOSSIL2 model at several levels. Volumes II and III of this report list the equations that comprise the FOSSIL2 model, along with variable definitions and a cross-reference list of the model variables. Volume II provides the model equations with each of their variables defined, while Volume III lists the equations, and a one line definition for equations, in a shorter, more readable format.

4940 (DOE/PE/70143—02(Vol.3)) FOSSIL2 energy policy model documentation: FOSSIL2 documentation. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Oct 1980. Contract AC01-79PE70143. 132p. NTIS, PC A07/MF A01.

This report discusses the structure, derivations, assumptions, and mathematical formulation of the FOSSIL2 model. Each major facet of the model - supply/demand interactions, industry financing, and production - has been designed to parallel closely the actual cause/effect relationships determining the behavior of the United States energy system. The data base for the FOSSIL2 program is large, as is appropriate for a system dynamics simulation model. When possible, all data were obtained from sources well known to experts in the energy field. Cost and resource estimates are based on DOE data whenever possible. This report presents the FOSSIL2 model at several levels. Volumes II and III of this report list the equations that comprise the FOSSIL2 model, along with variable definitions and a cross-reference list of the model variables. Volume III lists the model equations and a one line definition for equations, in a short, readable format.

4941 (P—110-80-001) Toward a theory of California's gasoline shortages. Goldstone, S. (California Energy Commission, Sacramento (USA)). Jun 1980. 38p. California Energy Commission, Sacramento, CA.

This report develops a theory of California's recent gasoline shortages which provides a framework for evaluating relevant government policies. Panic buying was concluded not a primary cause of gasoline shortages although it may have exacerbated the situation. A more satisfactory explanation of the shortages was traced to the federal price regulations which aimed at cushioning the domestic consumer from the huge 1973-1974 OPEC increase in crude oil prices by means of: price ceilings on domestic crude oil; crude oil allocation and entitlements program; and price ceilings on refined products. Until recently, price ceilings have been nonbinding (i.e., higher than market clearing prices). However, gasoline shortages occurred as price ceilings became binding through various economic events. Examinations reveal that, even after the crude oil price ceiling and entitlement programs are taken into account, little, if any, benefits to the consumer may be attributed to the regulations. While it is true that price ceilings that do not bind do not yield consumer benefits, one may not conclude obversely that binding price ceilings do. Recent shortages, if anything, reveal that binding price ceilings are not sufficient by themselves to benefit consumers. In future evaluation of pricing policy initiatives, it is desirable to distinguish four separate cases: price controls that are likely to be nonbinding; price controls that are binding but are not accompanied by an efficient rationing scheme; price controls that are binding and accompanied by an efficient (and equitable) rationing scheme; and price decontrol. To date, we have had a mix of one and two; either three or four would be better.

4942 (PB—80-928108) Central Siberian brown coal as a potential source of power for European Russia. Research paper. (Central Intelligence Agency, Washington, DC (USA)). Apr 1980. 12p. NTIS PC E02/MF A01.

The Soviets are exploring several technologies for using low-grade Siberian brown coal as a supplemental power source for the Western USSR; the most promising option appears to be the manufacture of semicoke and shipping it by rail to Western USSR. Implementation of this option would take 10 to 15 years, however, and Soviet planners may have to look seriously at other alternatives.

4943 Thirty-first annual institute on oil and gas law and taxation. Ernst, A.C. (ed.). New York, NY; Matthew Bender and Company, Inc. (1980). 580p. (CONF-800257—).

From 31. annual institute on oil and gas law and taxation; Dallas, TX, USA (13 Feb 1980).

This volume contains discussions of important legal and tax problems of the oil and gas industry. Lecture titles are: crude oil pricing - current regulations and the shift to decontrol; current issues concerning DOE regulation of natural gas liquids, development and trends in DOE enforcement; ethical considerations in the energy law practice producer regulation under the natural gas policy act; operators liability for overcharges in the sale of production; the modern oil and gas lease; oil and gas royalty problems; is there a new implied covenant of explorvelopment; the OCS Land Act Ammendments of 1978-1980 and beyond; recent developments in the nonregulatory oil and gas law, current developments in oil and gas taxation; income taxation and solid minerals; organizing and terminating the oil and gas partnership; crude oil Windfall Profit Tax Act of 1980; and income realization in mineral sharing transactions - the pool of capital doctrine. (DMC)

4944 Coal simulation model used during the 1977-78 coal strike. Yen, V.C. (Ohio Department of Energy, Columbus). pp 225-234 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

A computer-based coal-simulation model was developed by the Ohio Department of Energy prior to the long coal strike of 1977-78. The main purpose of the model is two-fold: (1) to monitor the coal days' supply of all major sectors utilizing coal in the state; and, (2) to simulate the alternative effects in the electric utilities sector of conservation and curtailment policies. Advantages and weaknesses of the model are considered. More importantly, a set of questions fundamental to the structure of the model, e.g., defining coal days' supply, is briefly discussed.

4945 Effective use of petroleum. London, England; Heyden and Son, Inc. (1979). 277p. (CONF-7811177—). Inst. of Petroleum, London, England.

From Institute of Petroleum annual conference; London, UK (Nov 1978).

The purpose of this conference was to consider methods, both currently available and those planned for the future, for making the most effective use of petroleum products. Papers were presented on the outlook for oil, oil as a heat source, oil in transport, and oil and the food industry. Individual papers were abstracted.

4946 Energy outlook for the United Kingdom. Eden, R.J. (Univ. of Cambridge, England). pp 7-21 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

If the limits to growth in world oil supplies are adequately anticipated and provided against through the action of both major energy consumers and major energy producers, there is no reason why energy scarcity should prevent reasonable levels of world economic growth at least over the next 20 years. The necessary action includes energy conservation, the development of higher cost sources of oil and the development of energy supplies alternative to oil, particularly coal and nuclear in the medium-term future. Such action could be encouraged by a steady increase in the real price of oil, perhaps at 5% per annum throughout the 1980s. The UK could contribute in each of these areas; through conservation in all sectors, through North Sea oil and gas, and through the development of coal and nuclear supplies, which could help release more of our oil supplies for export or prolong the useful life of our reserves. On the other hand, if there is not sufficient active anticipation of the limits to growth in world oil supplies, and major energy consumers and producers do not take the necessary action, there is a real possibility of a repeat of the 1973 oil crisis during the 1980s, with a sharp jump in world oil prices followed by economic recession.

2950 Hydrogen And Synthetic Fuels

4947 **1975 US synthetic fuels program analysis: interfaces between analysts and the decision process.** Cazalet, E.G. (Decision Focus Inc., Palo Alto, CA). pp 333-349 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

This review of the analysis of President Ford's 1975 synthetic-fuels commercialization program highlights the role of analysts in a decision process involving the President, a Federal task force, and Congress. Both large-scale energy models and decision analysis were used to structure the information available to the task force. The models and analysis techniques also provided a very-effective framework for debate within the task force that led to major changes in the President's program. The analysis, however, was much-less effective in the advocacy process that followed the completion of the task force's work, although it did play a significant role in the final decision by the Congress to reject the President's program. In view of President Carter's similar synthetic fuels incentives, the 1975 study is of current interest and is relevant to the use of models and analysis in any future study of the Carter proposals.

2960 Electric Power

4948 **(DOE/EIA—0044(79)) Statistics of privately owned electric utilities in the United States: 1979. Classes A and B companies.** Roth, K.A.; Lyles, R.C. (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1980. 616p. NTIS, PC A99/MF A01.

This publication presents the 43rd consecutive year of comprehensive financial and operating information on all the large privately owned electric utility companies operating in the United States. The information has been taken from the annual reports of Classes A and B electric utilities presented to the Energy Information Administration (EIA) for the year 1979. Class A utilities are those having an annual electric operating revenue of $2.5 million or more. Class B utilities are those with an annual electric operating revenue of $1 million or more, but less than $2.5 million. The information on electric utility net generation which pertains to the entire electric utility industry is compiled from monthly reports of electricity generation filed with the EIA by all electric utilities operating generating facilities. By the end of 1979, there were 205 Classes A and B companies in operation; in 1978, there were 210 Classes A and B companies in operation. The tabulated schedules contained in this report include balance sheets; income and retained earnings statements; statements of changes in financial position; electric operating revenues; customers and sales by classes of service; electric operation and maintenance expenses; utility plant; physical quantities; rates of return on electric utility rate base; rates of return on common equity; interest coverage and capitalization ratios; and advertising and sales expense. A section detailing environmental protection facilities and actual expenses incurred is included for the fourth time in 1979. The schedules of this report are based upon the statement accounts and other statistics submitted by the companies in their reports to the Federal Energy Regulatory Commission (FERC). These schedules present the accounts of individual companies only. The accounts of parent and subsidiary companies are not consolidated.

4949 **(DOE/EIA—0180(78)) Gas turbine electric plant construction cost and annual production expenses, 1978. Sixth annual supplement.** Lay, C.L.; Prete, L.J. (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1980. 143p. NTIS, PC A07/MF A01.

This supplement presents detailed data for 1978 on plant investment, annual production expenses, and related information for 435 of the major gas turbine power plants of 10 MW or larger in the U.S. These data are included on the accompanying plant data sheets. These data were taken from the 1978 Annual Reports of privately-owned electric utilities, and publicly-owned electric utilities, supplemented by data on some physical and operating characteristics taken from the 1978 Annual Power System Statement and the Monthly Power Plant Report.

4950 **(DOE/EIA—0226(80/06)) Electric power monthly, June 1980.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 24 Sep 1980. 141p. GPO.

This report presents monthly summaries of electric utility statistics at the national, regional, state, or local levels on the following subjects: net generation; net energy for load; peak load and net capability; consumption (fuel); stocks (fuel); deliveries (fuel); and price (fuel deliveries and retail electricity).

4951 **(DOE/RG—0044) Guide to authorization procedures for the international export of electricity and electric power lines crossing international borders.** (Department of Energy, Washington, DC (USA)). Nov 1980. 17p. NTIS, PC A02/MF A01.

The Economic Regulatory Administration (ERA) has prepared this guide to assist utilities and other entities in filing applications for (1) authorizations to export electricity and (2) Presidential Permits. The guide is not intended to be all inclusive; however, it will provide an applicant with the type of information required in the application, define lead times, and direct an applicant to the proper source documents for preparing a complete application. The booklet is organized into two sections. The first part outlines the procedures for preparing an application for authorization to export electricity. The second part outlines the procedures for applying for a Presidential Permit to construct, connect, operate, or maintain electric transmission facilities at international boundaries.

4952 **(EAC-R—4015) Satellite Power System (SPS) utility integration: institutional, planning and operational issues.** Crist, M.; Hill, J.; Kotin, A.D.; Rabe, J.A. (PRC Energy Analysis Co., Los Angeles, CA (USA)). Oct 1980. Contract AC01-79ER10041. 202p. NTIS, PC A10/MF A01.

Significant institutional barriers exist which would tend to inhibit financial participation in the SPS program by the US utility industry. Reluctance to participate would persist at least until the first SPS unit has been successfully demonstrated. At that time, commitments to bulk power purchase from SPS (with suitable guarantees on pricing and availability) or rectenna ownership might become attractive to the utility industry. Ownership of both rectennas and satellites by US utilities, however, is not likely to be considered until after several such units have a demonstrated record of success. In any event, new management and organizational arrangements will be needed to incorporate 300 GW of SPS electricity into the US utility grid. Locating a sufficient number of suitable rectenna sites in the eastern United States to serve projected load centers on a proportional basis would appear to be difficult. Transmission distances from rectennas to load centers could be a problem in the western United States. Long transmission distances are undesirable from a technical point of view but can be managed. More significant is the fact that long transmission lines associated with SPS

would consistently cross state (and other regulatory) boundaries. However, siting exercises suggest that 60 rectennas could be located in eligible areas within the continental United States to serve projected load centers without violating the current state-of-the-art of electricity transmission and load management.

4953 **(EPRI-P—1597-SR) Research and development by the electric utilty industry.** (Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1980. 93p. NTIS, PC A05/MF A01.

Recommendations on an appropriate level of research and development (R and D) by the electric utility industry are presented. As background to these recommendations, the study examines: the history of electric utility R and D; the roles of the utilities, the equipment suppliers, and federal government in support of R and D; R and D activities of critical importance to the electric utilities and their customers; short-, medium-, and long-term R and D emphasis; recommendations of the CONAES study; and the role of the Electric Power Research Institute (EPRI). Detailed appendixes compare federal and EPRI R and D activities in seven strategic areas, provide a history of EPRI's R and D program, list examples of ways in which EPRI R and D results are currently benefitting electric utilties and their customers, evaluate the role of R and D in technological progress, and provide data on R and D expenditures in the US industry in general and the electric utility industry in particular.

4954 **(P—102-79-007) Electrical generation. Volume 1. Technical Assessment manual. Appendices, version one.** (California Energy Commission, Sacramento (USA)). Sep 1979. 67p. California Energy Commission, Sacramento.

This document was prepared by staff of the State of California Energy Commission to support staff analysis and technology assessments of electric power generation projects. This appendix contains information on: modeling of make-up water requirements for power plant cooling towers; lead times for various power plant technologies; nuclear fuel cost and performance; costs of decommissioning light water reactors; and capital cost estimations. (LCL)

4955 **(P—300-80-24) Costs and benefits of power pooling in California.** Badertscher, N.; Khan, S.; Markel, L.; Curtice, D.; Lee, S. (California Energy Commission, Sacramento (USA)). May 1980. 127p. California Energy Commisson, Sacramento.

Portions of document are illegible.

This study was performed to determine if increased power pooling among California's four largest utilities would reduce costs and improve reliability. Benefits examined included reduced production costs, fuel oil savings, sharing emergency generation, and reduced need for new power plants. Pooling costs examined were for new control centers and transmission lines. Standard utility analytical methods were employed. Production costs were calculated for the electric utilities operating individually, and operating as a single statewide system. The electrical demand used was the California Energy Commission's 1977 adopted forecast. Comparisons of individual and single system operation indicated that power pooling, using central dispatch, would result in cost savings, in 1990, of about $300 million, and oil savings of about nine million barrels. The costs of increased pooling (control center, transmission lines, and transmission losses) were estimated to be $100 million. Single system operation was shown to have significantly higher reliability than individual system operation. Calculations indicate that 5800 MW of new generation capacity could be delayed while maintaining statewide reliability. However, since most planned capacity additions are nonoilfired, delaying capacity results in 35 million barrels of additional oil use. This reduces the attractiveness of cost savings from capacity deferral in the near term.

4956 **(P—700-79-016) California Energy Commission staff caper. Issues related to reliability of power plants in California.** Shurley, L.A. (California Energy Commission, Sacramento (USA)). 1979. 66p. California Energy Commission, Sacramento.

Concern is expressed that without reexamination on the part of the industry of its past policies, traditions and practices, the power plants yet to be licensed in the State of California may not fulfill their full productivity potential. Also, this document seeks a recognition of all parties participating in the regulatory processes, that unless appropriate and deliberate measures are applied, the reliability of the future power generating facilities may be inconsistent with the energy needs, and consequently the reliability deficiency may have to be compensated for by construction of additional generating units that otherwise should not be required. Accordingly, the causes and factors contributing to degradation of power plants reliability are identified, and various means of reduction (or elimination) of such causes, along with related economic aspects are discussed. Basic policies derived from the statutory requirements, the ensuing Commission's role, and the role of the Commission's staff relative to the reliability issues are identified. The contents of this document are applicable to any type of baseload power generating facility. The provided record, pointing to the need for reliability improvement covers the history of nuclear, geothermal, coal, gas, and oil-fired units. The record encompasses variables such as the generating unit size (MW) and the plant maturity (age). Also, certain facilities with exceptional productivity levels, which resuled from specific measures taken to achieve them, are identified. In addition to the specific measures that can be taken to increase the power plant's reliability, the recommendation to study the merits of incentivising the power industry to improve the productivity levels of future power plants is included.

4957 **(PNL—3401) Social issues and energy alternatives: the context of conflict over nuclear waste. Final report.** Lindell, M.K.; Earle, T.C.; Perry, R.W. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Jun 1980. Contract AC06-76RL01830. 67p. (B-HARC—411/80/033). NTIS, PC A04/MF A01.

The perceived risks and benefits of electric power alternatives were used to explore the context of attitudes toward nuclear power. Supporters and opponents of nuclear power responded to thirty-three items which referred to five categories of energy issue: the production potential of electric, risks of those technologies, power generation technologies, energy conservation, comparisons of risks among technologies and comparisons between risks and benefits of each technology. The results are summarized. The nuclear supporters studied here do favor nuclear power. However, they believe that there are limited prospects for contributions from solar, wind and hydroelectric technologies. They also believe that there are serious disadvantages to conservation. Nuclear opponents, on the other hand, disagree that there are such limited prospects for solar and wind, although they are neutral on the prospects for increased hydro capacity. They also do not believe that conservation necessarily poses serious adverse consequences either for themselves or others.

4958 **(PNL—3404) Attutude-action consistency and social policy related to nuclear technology.** Lindell, M.K.; Perry, R.W.; Greene, M. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Jun 1980. Contract AC06-76RL01830. 27p. (B-HARC—411/80/030). NTIS, PC A03/MF A01.

This study reports the results of a further analysis of questionnaire data--parts of which have been previously reported by Lindell, Earle, Hebert and Perry (1978)--that are related to the issue of consistency of attitudes and behavior toward nuclear power and nuclear waste management. Three factors are considered that might be expected to have a significant bearing on attitude-action consistency: social support, attitude object importance and past activism. Analysis of the data indicated that pronuclear responderts were more likely to show consistency of attitudes and actions (66%) than were antinuclear respondents (51%) although the difference in proportions is not statistically significant. Further analyses showed a strong positive relation between attitude-action consistency and perceived social support, measured by the degree to which the respondent believed that close friends and work associated agreed with his attitude. This relationship held up even when controls for attitude object importance and past activism were introduced. Attitude object importance--the salience of the issue of energy shortage--had a statistically significant effect only when perceived social support was low. Past activism had no significant relation to attitude-action consistency. These data suggest that the level of active support for or opposition to nuclear technology will be affected by the distribution of favorable and unfavorable atti-

tudes among residents of an area. Situations in which pro- and antinuclear attitudes are concentrated among members of interacting groups, rather than distributed randomly, are more likely to produce high levels of polarization.

4959 **Mid-range forecasting of the load-duration curve.** Uri, N.D. (Oil and Gas Analysis Division, Washington, DC). *GBApplied Mathematical Modelling (England);* **3**: No. 5, 379-383(Oct 1979).

Mr. Uri says that little has been done by way of developing an objective technique for mid-range forecasting of a utility load-duration curve. This paper endeavors to rectify this situation by developing a methodology to provide forecasts of economically optimal approximations to the curve. A dynamic programming algorithm serves as the basis of the optimal approximations over a known horizon. These approximations are then forecast using time-series analysis and a suitable transformation model. The approach is implemented and the results are most acceptable. 7 references, 1 figure, 4 tables.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 4969, 4973, 4980, 4981, 4988, 5004

4960 **Dynamic modeling using advanced time-series techniques: energy-GNP and energy-employment interactions.** Akarca, A.T.; Long, T.V. II. (Univ. of Chicago, IL). pp 501-516 of Energy Modeling II: interface between model builder and decision maker. Chicago, IL; Institute of Gas Technology (1980).

From IGT symposium on energy modeling II: the interface between model builder and decision maker; Colorado Springs, CO, USA (13 Aug 1979).

Advanced time-series techniques that build on the work of Sims (1972) and Box and Jenkins (1976) are utilized to define the direction of causality and the precise lag structure between gross energy consumption (GEC) and GNP and between energy and total employment. Based on annual data, there is no evidence for unidirectional causality running from GNP to GEC or from GEC to GNP. Only a strong contemporaneous link between the two variables is supported. Earlier results by Kraft and Kraft (1978), which suggested unidirectional causality from GNP to GEC, are shown to be spurious. Unidirectional causality is shown to attain for energy and employment, such that a decrease (increase) in energy consumption is followed eight months later by an increase (decrease) in employment. The effect of the energy shock on employment is completed within a year's time, and the long-run elasticity is -0.136. The use of bivariate time-series models in forecasting is illustrated.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

4961 (CONF-801079—, pp V.65-V.66) **Testing and evaluation heat recovery/seed recovery components for MHD systems.** Wehr, A.G.; Murphree, D.L. (Mississippi State Univ., MS). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The overall objective of this research is to establish a data base on heat transfer, slagging effects on heat transfer surfaces, metal durability, secondary combustor performance, secondary combustor design requirements, and other information pertinent to the design of heat recovery, seed recovery (HRSR) components for MHD systems. This work will be performed by utilizing the Mississippi State University MHD test stand which can simulate the gas-slag-seed stream and the thermal conditions present in a coal-fired MHD plant.

4962 (CONF-801079—, pp VI.6-VI.7) **MHD electrode development.** Rossing, B.R. (Westinghouse Electric Corp., Pittsburgh, PA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The primary objective of this program is the comprehensive engineering development of electrode systems for coal-fired MHD generators. The program provides for the engineering development of electrode and insulating wall systems through design, materials fabrication, initial screening tests, construction and fianlly to an MHD system test. The entire sequence is reiterative, i.e., each stage will involve an optimization of design and/or materials. A variety of refractory materials have been evaluated as to their resistance to electrochemical corrosion by slags. Several of these materials ($MgCr_2O_4$, single crystal Y_2O_3 stabilized zirconia, platinum and iron) have been recommended for future engineering rig tests. An experimental laboratory arrangement has been established to measure anode arc erosion. These measurements are to be used to study the effects of anode surface temerature, slag-seed chemistry and arc properties on the arc erosion of various anode materials. The Westinghouse Electrode Systems Test Facility (WESTF) has been modified to include a 3 Tesla magnet. All MHD effects can be simulated in this facility.

4963 (CONF-801079—, pp VI.8-VI.12) **MHD air heater development materials technology.** Smyth, R.R.; Saari, D.P. (FluiDyne Engineering Corp., Minneapolis, MN). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The directly-fired MHD Air Heater uses MHD channel off gases at temperatures up to 2000 K to preheat combustion air. This process permits high efficiencies to be realized in MHD electric power generation but presents challenging materials problems. In addition to high, cyclic temperatures, materials must withstand high levels of alkali vapor and liquid coal ash. The objective of our program is to evaluate and select materials for such service and develop a data base suitable for use in fullscale design. The program includes operation of a subscale air heater and a high temperature valve for studies of directly-fired air heater operating characteristics and materials durability. Materials are either selected from commercial lines or made specifically for this application by refractory companies. Previously reported long term tests with fusion cast magnesia 35% alumina cored brick and a spinel castable hot liner have demonstrated the viability of these materials. Cored bricks of the fusion cast material have been tested for a total of 1170 hours. More recently the operation of a high temperature valve has been demonstrated and chromia containing refractories have been investigated further.

4964 (CONF-801079—, pp VI.13-VI.18) **Seed/slag interactions and effects.** Hosler, W.R.; Plante, E.R.; Smit, J.; Cook, L.P. (National Bureau of Standards, Washington, DC). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

This task can be divided into three major categories: (1) Phase Equilibria and Vaporization (2) Conductivity and (3) Corrosion. For thermochemistry the objective of the task is to determine the significant chemical differences between slags produced by MHD combustion of sub-bituminous or Western, and bituminous or Eastern coals and their interaction with seeded combustion products. For conductivity the object is to identify the process of electrical change transport and the relationship of this process to electrochemical degradation of materials found in the duct wall of a coal fired MHD generator. The objectives of the corrosion portion of the program are: 1) to develop a test method for assessing the relative corrosion resistance of alloys in downstream components of MHD systems; 2) to screen alloys for corrosion resistance under some simulated downstream conditions; and 3) to evaluate the materials subjected to tests in 2 to determine the conditions under which screened alloys may be suitable candidates for incorporation in the design of downstream components.

4965 (CONF-801079—, pp VI.19-VI.20) **Materials research for the clean utilization of coal task 1: creep and other properties of refractories.** Schneider, S.J. (National Bureau of Standards, Washington, DC). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objectives of the task are to obtain data on the high temperature compressive creep of the refractories being considered

for use in MHD air preheaters; and to rank the proposed refractories in terms of their creep resistance at the proposed service temperatures of 1400 to 1600°C. The work is organized into 6 subtasks: Compressive yield strength as a function of temperatures; dimensional change as a function of temperature; creep ranking test; design and construction of compressive creep equipment for obtaining data on 12 specimens; long term creep data to 1000 hours; and dimensional change as a function of temperature cycling. Samples of refractories used in the Montana State University air preheater test apparatus were tested in compression 1) at constant load and 2) at constant loading rate at 1400°C, 1500°C, and 1600°C.

4966 (DOE/ET/15602—T2) MHD air heater development technology. Technical progress report, April 1, 1980-June 30, 1980. (FluiDyne Engineering Corp., Minneapolis, MN (USA)). Jul 1980. Contract AC01-80ET15602. 54p. NTIS, PC A03/MF A01.

Technology development for the directly-fired high temperature air heater (HTAH) for MHD power plants is described. Work is being done under three tasks as described in the following. (1) materials selection, evaluation, and development: The objective of this task is to continue development of ceramic materials technology for the directly-fired HTAH. The scope of the work will include compilation of materials data, materials selection for testing and design studies, materials property determination, liaison with refractory manufacturers and other organizations to encourage development of materials and fabrication technology, establishment of preliminary HTAH material specifications, analyses of test materials, and development of criteria for thermal stress limits for crack-tolerant refractory materials. (2) operability, performance, and materials testing: The objectives of this task are to demonstrate the technical feasibility of operating a directly-fired HTAH (including both the heater matrix and valves), to continue obtaining information on life and corrosion resistance of HTAH materials, and to obtain design information for full-scale studies and future design work. (3) full-scale design concepts: The objectives of this task are to begin the identification of HTAH control requirements and control system needs, and to continue full-scale study efforts incorporating updated materials and design information in order to identify development needs for the HTAH development program. Progress is described. (WHK)

3003 Thermoelectric Generators

REFER ALSO TO CITATION(S) 4609, 4610

3005 Fuel Cells

REFER ALSO TO CITATION(S) 5036

4967 (DOE/ET/11322—T3) Performance model for molten carbonate fuel cells. Quarterly progress report, 5 October 1978 through 5 January 1979. Wilemski, G.; Wolf, T.; Bloomfield, D.; Finson, M.L.; Pugh, E.R.; Wray, K.L. (Physical Sciences, Inc., Woburn, MA (USA)). 1979. Contract AC02-78ET11322. 54p. (TR—163). NTIS, PC A04/MF A01.

Progress on the development of a performance model for molten carbonate fuel cells is reported. Key physical and chemical phenomena being modeled include mass transport, ohmic losses, electrode kinetics, fuel and oxidant utilization, and convective heat transfer. Numerical schemes have been developed and programmed to calculate overpotential versus current density curves for individual electrodes, the cell current density distribution, and the cell temperature distribution, neglecting the effects of in-plane heat conduction.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

4968 (BNL—51173) Optimal timing of investment in energy conservation technology. Ravid, S.A. (Brookhaven National Lab., Upton, NY (USA)). Jul 1978. Contract AC02-76CH00016. 29p. NTIS, PC A03/MF A01.

It is assumed that an energy-conserving technological invention has been made. Given the cost of equipment replacement and future energy prices, optimal investment time in the new equipment is calculated. Various assumptions are made about the nature of replacement, its cost, and the equipment available, including the assumption that further technological progress will occur in the future. Replacement models as well as dynamic programming formulations are drawn upon. A major result is that replacement should take place when its marginal benefits equal those of the alternative marginal use of the investment funds required. Finally, an attempt is made to quantify maximum economically beneficial development outlays for the projects analyzed.

4969 (EPRI-EA—518) Stochastic sensitivity analysis of US input-output model. Final report. Bullard, C.W. (Illinois Univ., Urbana (USA)). Oct 1980. 84p. NTIS, PC A05/MF A01.

Input-output tables have been used in a wide variety of energy analyses to examine the economic impacts of changes in demand due to changes in the cost and availability of energy. There have been several questions concerning their use in general and the applicability of these to energy issues. This report describes a simulation that is used to measure the propagation of uncertainty through input-output calculations. This research developed measures of uncertainty and probability distributions for published input values. A Monte Carlo simulation was utilized to develop the distributions of sector outputs for 30-, 90-, and 101-sector tables.

3201 Buildings

4970 Alternative technologies for US residential water heating: energy savings and economic benefits. Hirst, E.; Carney, J.; O'Neal, D. (Oak Ridge National Lab., TN). *GBEnergy Policy (England);* 7: No. 4, 307-320(Dec 1979).

Introducing heat-pump and solar water heaters to the US residential market and a tax credit for solar installations offers energy saving and direct economic benefits. Energy savings are estimated for ten regions of the USA, as well as for the country as a whole, over the period 1977 to 2000. Changes in annual fuel bills and capital costs for water heaters are also computed. Comparisons suggest that heat-pump water heaters are likely to offer much larger benefits than solar heaters, even with tax credits. This is because heat pumps provide the same electricity savings (about 50%), but at a much lower capital cost. 31 references, 8 figures, 4 tables.

4971 (BNL—51240) Variable firing rate power burner for high efficiency gas furnaces. Final report. Fuller, H.H.; Demler, R.L.; Poulin, E. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Feb 1980. Contract AC02-76CH00016. 30p. NTIS, PC A03/MF A01.

One method for increasing the efficiency of residential furnaces and boilers is to retrofit a burner capable of firing rate (FR) modulation. While maximum FR is still attainable, the average FR is significantly lower, resulting in more effective heat exchanger performance. Equally important is the capability for continuous firing at a very low rate (simmering) which eliminates off-cycle loss, a heavy contributor to inefficiency. Additional performance can be gained by reducing the excess air required by a burner. Based on its previous experience, Foster-Miller Associates, Inc. has designed and tested a low excess air (about 15%) variable firing rate (VFR) burner. The theory of operation and the construction of the test burner are described. Test results are given along with a conclusion/recommendation. A Phase II plan is outlined which suggests methods and steps for fabrication and field testing of a number of prototype units.

4972 (CONF-800451—3) Finned tube heat exchangers: state of the art for the air side. McQuiston, F.C. (Oklahoma State Univ., Stillwater (USA)). 1980. Contract AS05-76ET20312. 23p. NTIS, PC A02/MF A01.

From 5. annual heat pump technology conference; Stillwater, OK, USA (14 Apr 1980).

The findings of various investigators during the past ten years has greatly enhanced our ability to analyze, model, design, and optimize the finned tube heat exchangers so widely used in the HVAC business. The effect of rows, fin pitch, and other geometric

parameters are now well understood and generalized heat transfer correlations are available. The relation between heat and mass transfer has been much better defined and good correlations have been developed. Some advances have also been made in modeling techniques especially where partially dry cooling and dehumidifying coils are involved. All of these factors are reviewed to concisely summarize what is now available to the heat exchanger analyst.

4973 **(CONF-801152—1) Oak Ridge National Laboratory's residential energy-use model: Version 7.1.** O'Neal, D.L.; Vineyard, T.A. (Oak Ridge National Lab., TN (USA); Purdue Univ., Lafayette, IN (USA)). 1980. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01.

From Electric Power Research Institute workshop; Atlanta, GA, USA (17 Nov 1980).

The ORNL residential energy-use model simulates energy use in the residential sector from 1977 to 2005. The model provides considerable detail on annual energy use by fuel, end use, and housing type. It also estimates annual equipment installations and ownership, equipment energy requirements, structure thermal performance, fuel expenditures, equipment cost, and costs for improving thermal performance of new and existing housing units. Thus, the model provides considerable detail on residential energy uses and associated costs. These details are useful for evaluating alternative energy-conservation policies, programs, and technologies for their energy and economic effects during the next quarter century. The present version of the model (Version 7.1) incorporates changes in energy-use data and in the housing, technology, and market-penetration submodels. This paper describes the most-recent changes in the model and how these changes affect output from the model when compared to Version 6. A brief overview of the model is provided.

4974 **(CONF-810101—1) Conserving energy in domestic refrigerators through the use of refrigerant mixtures.** Stoecker, W.F.; Walukas, D.J. (Illinois Univ., Urbana (USA); Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01.

From American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) meeting; Chicago, IL, USA (25 Jan 1981).

Domestic refrigerators perform refrigeration at two temperature levels, so an applicable refrigeration cycle is one that employs two evaporators. If refrigerant mixture is used in the circuit and directed in series first through the low- and then the high-temperature evaporator, the progressively rising temperatures reduce the irreversibilities in the cycle. A literature review and then a series of simulations of several different cycles with varying mixtures of refrigerants are provided. In a single evaporator cycle the energy characteristics of a system utilizing the refrigerant mixture is improved significantly by the addition of a liquid-suction heat exchanger. In a system with two evaporators operating at two different temperature levels, the analysis showed a possibility of saving approximately 12% compressor power by using a 50/50% mixture of Refrigerant 12/Refrigerant 114 in comparison to pure Refrigerant 12 with the chosen values of evporator loads, and sizes of heat exchangers and evaporators. The results are encouraging, particularly since the cycle was not an optimized one, but on the other hand, heat-transfer coefficients for the mixture were assumed identical to those for the single refrigerant, and some researchers report a reduction for mixtures. Certain practical considerations, such as the behavior of the mixture with oil also must be explored.

4975 **(DOE/CS/20060—5120(Vol.2)) Groundwater heat pumps: an examination of hydrogeologic, environmental, legal, and economic factors affecting their use. Volume II. Appendix D, state hydrogeologic descriptions and maps.** (National Water Well Association, Worthington, OH (USA)). Nov 1980. Contract AC01-78CS20060. 104p. NTIS, PC A06/MF A01.

This appendix to the groundwater heat pump report contains hydrogeologic descriptions of the 48 conterminous US with data on ground water quality.

4976 **(DOE/R5/10153—T2) Simulation of conventional and Rumford fireplaces.** Norman, J.C. (Wisconsin Univ., Greenbay (USA). Coll. of Environmental Sciences). 1980. Contract FG02-79R510153. 25p. NTIS, PC A02/MF A01.

Count Rumford designed and constructed fireplaces which had a shallower fire box and higher front opening than conventional fireplaces. This design was based on his observation that a fireplace heats a room nearly entirely through radiation from the fire, and hence radiation transfer should be maximized. He claimed, but gave no quantitative experimental data to support, that his fireplaces were two to three times more efficient than those they replaced. In order to verify the superiority of the Rumford fireplace, a computer model of fireplace performance has been developed. This model was tested with measured performance data and found to simulate a real fireplace remarkably well. Using this model to calculate the radiation output for several different fireplace designs indicate that Rumford fireplaces are two to three times more efficient than conventional fireplaces.

4977 **(DOE/RG/08117—T1) I-SAVE conservation program. Implementing title II of NECPA residential conservation service. Final draft.** (Iowa State Commerce Commission, Des Moines (USA)). 30 May 1980. Contract FC01-77RG08117. 112p. NTIS, PC A06/MF A01.

The I-SAVE (Iowa Saves America's Vital Energy) conservation plan provides comprehensive energy-conservation information and services to residential consumers served by large investor-owned electric and gas utilities and participating home-heating suppliers. The overall objective of the I-SAVE plan is to conserve energy by facilitating cost-effective retrofit of existing housing and promoting more-efficient energy use. The ultimate benefit available to the customer under the I-SAVE plan - reduction in energy use - is dependent upon the action he or she takes as a result of the program audit. Benefits to the utility and the ratepayers as a whole, however, will accrue only upon widespread customer acceptance and utilization of program services. This degree of program acceptance and the resulting benefits to ratepayers can be attained only through an aggressive educational and promotional effort by the covered utilities. All electric and gas utilities which have sales, other than resale, exceeding 750 million kWh of electricity or 10 billion cubic feet of gas and participating home-heating suppliers, shall provide a program announcement and shall offer conservation services to their customers who occupy a residential building containing at least one, but not more than four units, in a manner as provided by the rules. The text of the rules is presented. (MCW)

4978 **(DOE/RG/08117—T2) Chapter 28. Iowa supplemental energy conservation plan.** (Iowa State Commerce Commission, Des Moines (USA)). 1980. Contract FC01-77RG08117. 35p. NTIS, PC A03/MF A01.

The Iowa supplemental energy conservation plan is designed to provide conservation services to those consumers who would not otherwise be offered services under the statewide I-SAVE conservation plan. The provisions of the plan are tailored to the needs and concerns of the small to medium-sized energy supplier and reflect a balance between effective conservation services, program participation, and cost-recovery ability. The plan applies to all electric and gas utilities not covered under the I-SAVE plan and to all suppliers of fuel oil, propane, and butane for home-heating purposes. Participation in the plan is voluntary. The text of the plan is presented.

4979 **(DOE/TIC—11357) Groundwater as an alternative energy source for space heating and cooling (geothermal heat extraction).** (Toledo Metropolitan Area Council of Governments, OH (USA)). Jul 1980. Contract W-31-109-ENG-38. 37p. NTIS, PC A03/MF A01.

The technology of the groundwater heat pump (GWHP), its applicability to the TMACOG (Toledo Metropolitan Area Council of Governments) region, and the relative economics of its use are addressed. The technical summary of the GWHP includes its operation in both the heating and cooling modes, the history of the GWHP and its relative advantages and disadvantages. The geographical and geological analysis of the TMACOG region identifies groundwater availability and accessibility, water quality, and environmental factors concerning its use. A comparison is made of

other heating and cooling systems both in operation and in cost. A detailed analysis is given to the legal implications of direct groundwater use and its related impacts. Conclusions are that GWHPs are feasible as an alternative energy source for Northwest Ohio and Southern Michigan. Groundwater supplies appear to be adequate and of reasonably good quality. GWHP technology is available, but limited marketing and use to date has caused difficulties in obtaining installation and maintenance of the systems. The use of the GWHP is an economical approach to heating and cooling buildings because of its minimum maintenance. Therefore, this technology should be developed as an alternative energy source for the future.

4980 **(EPRI-EA—1551(Pt.1)) User's guide for REAP (Residential Energy Analysis Program). Part 1. Data input preparation.** Talbert, S.; Jakob, F.E. (Battelle Columbus Labs., OH (USA)). Sep 1980. 254p. NTIS, PC A12/MF A01.

This user's guide for EPRI's Residential Energy Analysis Program (REAP) is the result of one of the tasks of Research Project 1364-1 (RP1364-1) entitled Analysis of Field Test Data on Residential Heating and Cooling. The objectives of the task were to provide documentation which describes how to use the program and also to provide sufficient background on the individual routines which would aid researchers in modifying the program to suit their needs. The approach taken was to address each objective in a separate volume of a two-part set. The first part deals solely with the data-input requirements of the REAP program. The input variables are described; the input format is presented; sources for data are cited; procedures are suggested which have been found to speed the data preparation tasks; Data Input Forms are provided which could be used when preparing the input data; and sample program inputs and outputs are also provided. The second part deals with the program structure. The user's guide therefore represents a consolidated document which describes the use and workings of REAP, a valuable research tool for determining residential space conditioning requirements.

4981 **(EPRI-EA—1551(Pt.2)) User's Guide for REAP (Residential Energy Analysis Program). Part 2. Program and preprocessor descriptions.** Talbert, S.; Jacob, F.E. (Battelle Columbus Labs., OH (USA)). Sep 1980. 195p. NTIS, PC E07/MF $3.50.

Recognizing that energy consumption for residential heating and cooling accounts for about one-eighth of total US energy consumption, EPRI's Demand and Conservation Program has pursued a series of projects aimed at a better understanding of this complicated end-use sector. A computer capable of calculating with high accuracy and detail of the heating and cooling requirements of residential buildings was developed. Through engineering analysis, detailed field measurements, and mathematical-simulation modeling, a state-of-the-art research computer code was developed and partially validated with actual field data. The overall objectives set forth for this project include: (1) validation of the generalized model with the remote field test data; (2) updating, extension, and documentation of the model; (3) analysis of the comparative performance of alternative heating systems; and (4) simplification of the model to provide a valid load-estimation technique. Part I deals with the data-input requirements of the REAP program; Part II deals with the program structure. It provides the insight into the algorithms used in the programs. This insight is necessary for those interested in modifying the model to suit particular needs. The different elements of the REAP program are discussed separately and background information is presented which traces the evolution of the routines to their current forms.

4982 **(LA-UR—80-2791) Comparison of DOE-2 computer program simulations to metered data for seven commercial buildings.** Diamond, S.C.; Hunn, B.D. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 21p. (CONF-810101—2). NTIS, PC A02/MF A01.

From American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) meeting; Chicago, IL, USA (25 Jan 1981).

As part of the DOE-2 Verification Project being conducted by the Los Alamos Scientific Laboratory, seven existing commercial buildings were simulated using the DOE-2 computer program. These buildings included a restaurant, single-floor office building, retail store, hospital, multifloor office building, school, and solar-heated and -cooled building. This comparison test required each building to be simulated by a separate contractor or national laboratory. Predictions of the DOE-2 computer program were then compared to the utility company monthly metered data. Results of these comparisons for gas/fuel oil use, electric energy use, and total energy use are reported.

4983 **(LBL—9933) Thermal performance of managed window systems.** Selkowitz, S.E.; Bazjanac, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 20p. (CONF-791233—10). NTIS, PC A02/MF A01.

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The primary factors that determine the net thermal performance of a window system are its overall heat transfer rate (U-value), its air leakage characteristics and its sun control capability. With managed window systems these basic properties may be drastically altered on an hourly basis as movable insulating and shading devices are deployed over the prime windows. A large building energy analysis computer program, DOE-2, has been modified to model the thermal performance of a variety of window management devices. The deployment of these devices is simulated based upon fixed hourly schedules or the value of critical climatic factors such as solar intensity. Automatic operation may be modeled or manual operation with varying degrees of human fallibility may be simulated. The model couples reductions in infiltration rate to the deployment of an insulating or shading device. Results of heating load calculations are presented for the cases of single- and double-glazed windows in a typical house with glass-to-floor area ratios of 15 to 40%, and for window management devices with varying thermal resistance, air leakage rates, and different modes of operation.

4984 **(LBL—11254) High intensity discharge 400-watt sodium ballast. Phase I. Final report.** Felper, G. (Data Power, Inc., Santa Ana, CA (USA)). Jun 1980. Contract W-7405-ENG-48. 48p. (EEB-L—80-05). NTIS, PC A03/MF A01.

The results of a research and development program directed toward design, test, and evaluation of energy efficient High Intensity Discharge (HID) Solid State 400-Watt Ballast lighting system are reported. Phase I of the project which was designed to modify the existing Datapower ballast to LBL configuration, measure performance characteristics, and compare efficiency with a core/coil ballast including energy loss analysis is covered. In addition, Datapower was tasked to build six (6) prototype 400-Watt High Pressure Sodium Ballasts for verification tests by an independent test facility and follow-on performance and life tests at LBL.

4985 **(LBL—11255) Electronic screw-in ballast and improved circline lamp phase I. Final report.** Kohler, T.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1980. Contract W-7405-ENG-48. 30p. (EEB-L—80-06). NTIS, PC A03/MF A01.

A solid state ballast has been designed for the efficient operation of a 10 in circline fluorescent lamp. The circuit can be manufactured using power hybrid technology. Eight discrete component versions of the ballasts have been delivered to LBL for testing. The results show the solid state fluorescent ballast system is more efficient than the core-coil ballasted systems on the market.

4986 **(LBL—11619) On-site demonstration procedure for solid-state fluorescent ballast.** Verderber, R.; Morse, O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1980. Contract W-7405-ENG-48. 29p. (EEB-L—80-07). NTIS, PC A03/MF A01.

The report was presented to plant engineers and managers who were involved in an on-site demonstration of EETech solid-state ballasts for two 40-watt T12 fluorescent lamps. The report includes a brief review of the operating principles of solid-state fluorescent ballasts and the status of development achieved during the LBL program. The remainder of the test describes the techniques of managing and instrumenting a test area for assessing the performance of solid-state fluorescent ballasts at an occupied site.

4987 **(NE/HETV—80/9) Energy out of groundwater.** Agerstrand, T.; Eriksson, L.O. (Viak AB, Vaellingby (Sweden)). Mar 1980. 42p. (In Swedish). NTIS, PC A03/MF A01.

The purpose of this inventory is to estimate those energy resources of the built-up area which are stored in aquifers with good tapping facilities. It is presumed that the energy is extracted by conventional heat pump technique in a relatively big scale. Following conditions have to be met: (1) adequate access to ground water having ample and stable temperature, (2) facilities to exploit the ground water at a lower temperature, (3) a well built-up residential area, and (4) access to reasonably priced momentum power for the heat pump. The inventory is based on the following assumptions: (1) the potential tapping points have been localized with the support of earlier investigations and by the appraisement of the hydrogeological experts of VIAK; (2) the temperature of the ground water at the depth of 10 m must be higher than 4.5°C, which excludes the provinces of Jaemtland, Vaesterbotten and Norrbotten; (3) the capacities of tapping more than 100 l/sec and between 25 and 100 l/sec have been stated paying regard to the sizes of the built-up areas; and (4) the calculated effects are based upon 60°C as the condensation temperature of the heat pump and the lowering of the temperature to +1°C. The total power requirement per tenement will be 5. kW. Thus ~ 295,000 tenements in build-up areas can be supplied with heat to 90% of their yearly requirement by means of energy from ground water and the heat pump. Conflict of interests reduce the coverage to ~ 184,000 tenements which means ~ 9% of the total number.

4988 **(NYSERDA—80-4) Energy conservation potential in low-rise, high-density housing.** (Pratt Inst., Brooklyn, NY (USA)). Sep 1980. 221p. NYSERDA, Albany, NY.

The result of a year's investigation into the energy conservation potential in new urban residential construction is reported. It was made by a Study Team comprised of Pratt Institute faculty, students, and outside consultants. First, a careful study was made of the energy consumption in eleven existing New York Housing Authority projects. With this background, and with the current New York State Energy Conservation Construction Code as a design parameter, the Team designed and analyzed a row house-type base building. Investigation continued with the analysis - by computer simulation - of the effects of 113 design options, or variances to the base building. The energy use characteristics were further evaluated economically under several funding and inflation-rate assumptions. Then the most cost-effective options were ranked, and four extremely efficient, innovative composite buildings hypothesized. The results of this study should prove useful in the design of urban infill housing, as well as providing a beginning for further investigation in the area of energy-efficient, low-rise, high-density housing.

4989 **(ORNL/CON—61) Experimental plan for investigating building-earth heat transfer at the Joint Institute for Heavy Ion Research Building.** Childs, K.W. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01.

An experimental plan is presented for investigating heat transfer between below-grade portions of building envelopes and the surrounding soil. Included is a detailing of data to be collected at an earth-sheltered structure (Joint Institute for Heavy Ion Research Building) to be constructed at Oak Ridge National Laboratory. The attributes of the required data collection instrumentation are defined and a program to assure the accuracy of the collected data is discussed. The experimental plan is intended to be used as a guide to selection, installation, and maintenance of instrumentation as well as in data collection and verification.

4990 **(ORNL/Sub—80/0082/1) Bi-radiant oven: a low-energy oven system. Volume I. Development and assessment.** DeWitt, D.P.; Peart, M.V. (Purdue Univ., Lafayette, IN (USA)). Apr 1980. Contract W-7405-ENG-26. 108p. NTIS, PC A06/MF A01.

The Bi-Radiant Oven system has three important features which provide improved performance. First, the cavity walls are highly reflective rather than absorptive thereby allowing these surfaces to operate at cooler temperatures. Second, the heating elements, similar in construction to those in a conventional oven, but operating at much lower temperatures, provide a prescribed, balanced radiant flux to the top and bottom surfaces of the food product. And third, the baking and roasting utensil has a highly absorptive finish. Instrumentation and methods of measurements have been developed for obtaining the important oven and food parameters during baking: wall, oven air, food and element temperatures; food mass loss rate; irradiance distribution; and convection heat flux. Observations on an experimental oven are presented and discussed. Thermal models relating the irradiance distribution to oven parameters have been compared with measurements using a new heat flux gage developed for the project. Using the DOE recommended test procedures, oven efficiencies of 20 to 23% have been measured. The heating requirements have been determined for seven food types: biscuits, meat loaf, baked foods, apple crisp, cornbread, macaroni and cheese casserole, and cheese souffle. Comparison of energy use with a conventional electric oven shows that energy savings greater than 50% can be realized. Detailed energy balances have been performed on two foods - beef roasts and yellow cake. Consideration of consumer acceptability of this new oven concept have been addressed.

4991 **(ORNL/SUB—7715/1) Operating temperatures for a convectively cooled recessed incandescent light fixture.** Yarbrough, D.W.; Toor, I. (Tennessee Technological Univ., Cookeville (USA)). Dec 1980. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01.

Test results are given for the operation of a recessed incandescent light fixture intended for residential use. The fixture is labeled for use in direct contact with attic thermal insulation. Temperature control of the powered fixture is provided by convective heat transfer from the ceiling side of the fixture. The fixture was operated at power levels up to two times the rated power of 75 watts and under thermal insulations up to R-40. In all operating configurations tested the fixture surface in contact with attic insulation was found to be less than 175°C. The observed surface temperatures are judged to be safe for operation in contact with loose-fill or batt-type insulations. It was observed that the power leads inside one fixture configuration are exposed to temperatures as high as 168°C. The electrical insulation could, therefore, have a limited life. The properties of the internal fixture wiring were not, however, studied in detail.

4992 **(ORNL/TM—7481) Analysis of heat transfer in building thermal insulation.** Fine, H.A.; Jury, S.H.; Yarbrough, D.W.; McElroy, D.L. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 87p. NTIS, PC A05/MF A01.

The measurement of the apparent thermal properties (i.e., conductivity, resistivity, and resistance) of insulation by the guarded hot-plate technique is mathematically simulated on a computer by assuming that coupled conductive and radiative heat transfer occurs in an absorbing and emitting single-phase gray medium. Calculations are performed for insulation extinction coefficients between 0.001 and 1000 ft^{-1}, thicknesses between 0.0208 and 1.0 ft, continuous-phase thermal conductivities between 0.1800 and 0.1980 Btu in./(h ft^2 °F), hot-plate temperatures between 485 and 635°R, and cold-plate temperatures between 435 and 585°R. A three-region approximate solution to coupled conductive and radiative heat transfer in an infinite slab of absorbing and emitting gray material bounded by black surfaces is also developed and shown to agree to within +-0.5% of the numerical results for most cases. The approximate solution to the coupled problem and the exact solution to the uncoupled problem are used to establish the effect of test conditions (such as specimen thickness, plate emissivity, plate temperatures, and continuous-phase thermal conductivity) on the measured apparent thermal properties of an insulation specimen. Examples of the temperature profiles within the insulation and a table of representative thicknesses for guarded hot-plate test specimens (i.e., the minimum specimen thickness required for measurement of an apparent thermal resistivity that is within 2% of the value at infinite thickness) are also presented. A means to extrapolate thermal resistance data from thin to thick specimens is suggested by ths analysis. Predictions from the extrapolation are shown to be consistent with existing thermal resistance data on low-density mineral fiber building insulation batts.

4993 (SIB-R—4-1980) Energy conservation in houses built from 1960. Andersson, A.C.; Fjaellstroem, H. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1980. 155p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01.

In the report an economic evaluation is done of different procedures for energy conservation in one family houses built from 1965 to 1975 in Sweden. The energy consumption has been studied through measurement of heat consumption and through calculations of heat balances. It was concluded that draught preventers for the windows and different procedures lowering the in-door temperature were the most efficient measures. Insulation of different parts of the buildings has also been discussed technically.

4994 (STU—78-3962) Residential heating with low temperature heat sources. Grudeborn, L.O. (Teknisk Utveckling HB, Goeteborg (Sweden)). Feb 1980. 10p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01.

Low temperature heat sources can not be used in ordinary water radiator systems for residential heating, because the surface area of the radiators has to be increased a lot if the water temperature decreases considerably below 80°C. On the other hand it is possible to use low temperature heat for space heating if you use heated air. An apparatus for heating of air with low temperature heat has been developed within this project. The temperature of the air has to be only 8 to 10°C over the normal room temperature.

4995 (TVA-EDT—122) Development of a system for off-peak electrical energy use by air conditioners and heat pumps. Russell, L.D. (Mississippi State Univ., Mississippi State (USA). Dept. of Mechanical Engineering). May 1980. 61p. (MSSU-EIRS-MS—80-1). NTIS, PC A04/MF A01.

This effort included investigation and evaluation of several alternatives for load management for the TVA system. Specific data for the TVA-system load characteristics were studied to determine the typical peak and off-peak periods for the system. The alternative systems investigated for load management included geaeous energy storage, phase-change-materials (PCM) energy storage, zeolite energy storage, variable-speed controllers for compressors, and weather-sensitive controllers. After investigating these alternatives, system-design criteria were established; then, the gaseous and PCM energy-storage systems were analyzed in detail. The system-design criteria include economic assessment of all alternatives; therefore, handbook data were developed for such economic assessment. Results indicated feasibility for a liquid/PCM energy-storage system; therefore, preliminary laboratory evaluation was made for such a system. Conclusions indicate that such a system is technically practical and potentially economical.

4996 Reflective insulating blinds for windows and the like. Barnes, P.R.; Shapira, H.B. (to Dept. of Energy). US Patent Application 101,367. 7 Dec 1979. 10p.

Energy-conserving window blinds are provided. The blinds are fabricated from coupled and adjustable slats, each slat having an insulation layer and a reflective surface to face outwardly when the blinds are closed. A range of desired light and air transmission may be selected with the reflective surfaces of the slats adapted to direct sunlight upward toward the ceiling when the blinds are open. When the blinds are closed, the insulation of the slats reduces the heat loss or gain produced by the windows. If desired, the reflective surfaces of the slats may be concave. The edges of the slats are designed to seal against adjacent slats when the blinds are closed to ensure minimum air flow between slats.

4997 Reducing energy demand in housing. Burton, R. (Energy Convenor, RIBA, London, England). pp 112-116 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

Measures for reducing energy consumption in existing buildings during the next 15 years and in new buildings with improved energy conversion systems further in the future are discussed. These measures include improved thermal insulation, lowered temperatures during the heating season, improved building design, heat recycling, heat storage, and small scale total energy systems. (LCL)

4998 (PB—80-166333) Efficiency of domestic hot water production out of the heating season. Current papers. Whittle, G.E.; Warren, P.R. (Building Research Station, Watford (England)). [nd]. 30p. NTIS PC E02/MF E02.

This paper compares the efficiencies of the main methods of providing domestic hot water out of the heating season. These include systems based upon appliances designed solely for water heating and also systems employing central heating boilers, which when supplying hot water only will be operating well below their design rating. Results are presented for an immersion heater, a gas circulator, a multipoint instantaneous gas water heater and five central heating appliances, four fired by gas and one by oil, and are used to discuss the effect on performance of appliance characteristics and methods of control. These studies are intended to provide a basis for decisions on the choice of appliance, controls and system characteristics for domestic water heating, and, consequently, to contribute to a reduction in future domestic energy consumption.

4999 (PB—80-166341) Field studies of the use of artificial lighting in offices. Current papers. Hunt, D.R.G.; Cockram, A.H. (Building Research Station, Watford (England)). [nd]. 60p. NTIS PC E02/MF E02.

Part 1 of this report describes field studies aimed at measuring the actual use of artificial lighting in offices in relation to the time of day, time of year, daylight illuminance, daylight factor and design illuminance, in order to provide data for calculations of energy savings based on current patterns of use. Part 2 of the report discusses methods of calculating possible energy and financial savings from the use of photoelectrically controlled systems.

3202 Transportation

REFER ALSO TO CITATION(S) 5030

5000 (ANL/CNSV-TM—44) Technology assessments in transportation: survey of recent literature. LaBelle, S.J. (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 245p. NTIS, PC A11/MF A01.

A survey and an evaluation of recent studies of transportation systems done in a technology-assessment framework were undertaken as the basis for a detailed statement of work for a US Department of Energy technology assessment of transportation energy-conservation strategies. Several bibliographies were searched and numerous professionals in the field of technology assessment were contacted regarding current work. Detailed abstracts were prepared for studies judged to be sufficiently broad in coverage of impacts assessed, yet detailed in coverage of all or part of the nation's transportation systems. Some studies were rich in data but not comprehensive in their analytical approach; brief abstracts were prepared for these. An explanation of the criteria used to screen the studies, as well as abstracts of 37 reports, are provided in this compendium of transportation-technology-assessment literature.

5001 (PB—80-165608) Analysis of the automobile market: modeling the long-run determinants of the demand for automobiles. Volume II - simulation analysis using the Wharton EFA automobile demand model. Final report, Sep 75-Mar 77. Schink, G.R.; Loxley, C.J. (Wharton (E.F.A.), Inc., Philadelphia, PA (USA)). Dec 1979. Contract DOT-TSC-1072. 353p. NTIS, PC A16/MF A01.

An econometric model is developed which provides long-run policy analysis and forecasting of annual trends, for U.S. auto stock, new sales, and their composition by auto size-class. The concept of 'desired' (equilibrium) stock is introduced. 'Desired stock' and its composition by size-class are related to numerous economic and demographic variables using cross-section data. Among them is a new 'capitalized cost per mile' measure, which expresses all costs over time relative to miles driven, discounted back to the present. New registrations, total and by class, and scrappage are found to be strongly related to 'desired stock' relative to actual stock, with other influences operating as 'speed of adjustment' factors. Fuel efficiency is analyzed in detail, relating mpg by class to physical vehicle characteristics and technological developments. Purchase prices and options expenditures are analyzed and all cost measures distinguished by foreign vs domestic origin as well as by size-class.

Volume I summarizes and describes the study, and contains a forecast through 2000. Volume II contains extensive simulation analysis, with public policy implications. Volume III contains data and methodology appendices.

5002 **(PB—80-166580) Analysis of the automobile market: modeling the long-run determinants of the demand for automobiles. Volume III - appendices to the Wharton EFA automobile demand model. Final report, Sep 75-Mar 77.** Schink, G.R.; Loxley, C.J. (Wharton (E.F.A.), Inc., Philadelphia, PA (USA)). Dec 1979. Contract DOT-TSC-1072. 274p. NTIS, PC A12/MF A01.

An econometric model is developed which provides long-run policy analysis and forecasting of annual trends, for U.S. auto stock, new sales, and their composition by auto size-class. The concept of 'desired' (equilibrium) stock is introduced. 'Desired stock' and its composition by size-class are related to numerous economic and demographic variables using cross-section data. Among them is a new 'capitalized cost per mile' measure, which expresses all costs over time relative to miles driven, discounted back to the present. New registrations, total and by class, and scrappage are found to be strongly related to 'desired stock' relative to actual stock, with other influences operating as 'speed of adjustment' factors. Fuel efficiency is analyzed in detail, relating mpg by class to physical vehicle characteristics and technological developments. Purchase prices and options expenditures are analyzed and all cost measures distinguished by foreign vs domestic origin as well as by size-class. Volume I summarizes and describes the study, and contains a forecast through 2000. Volume II contains extensive simulation analysis, with public policy implications. Volume III contains data and methodology appendices.

5003 **(UCRL—15044-1) Feasibility of an elastomeric regenerative braking system for automotive applications. Phase I. Final report.** Hoppie, L.O.; Chao, F.S.; Kalns, I.; Massey-Shaw, F.G.; Speranza, D.; Trela, D.M. (Eaton Engineering and Research Center, Southfield, MI (USA)). Apr 1979. Contract W-7405-ENG-48. 304p. NTIS, PC A14/MF A01.

A theoretical and experimental investigation into the use of elastomers as the energy storage element of a regenerative braking system for urban vehicles was carried out. This work culminated in the preliminary design of a complete full-scale system, the prediction of its performance and efficiency, the specification of its control system with the required actuators and sensors, and an analysis of its possible failure modes. The results indicate that such a system could be constructed from materials and components requiring neither new technology nor major development. Incorporation of the system would result in a savings of prime energy required at the drive line of at least 18% for the EPA Urban Driving Cycle, and would be cost effective if it can be manufactured and sold at less than about 12% of the selling price of the vehicle for which it is intended.

5004 **(UMTA-MA—06-0049-80-8) Rural public transportation projects on Indian reservations: a report on 11 demonstrations. Final report.** Crain, J.; Hodson, E. (Crain and Associates, Menlo Park, CA (USA)). May 1980. 205p. NTIS.

Eleven rural transportation demonstration projects involving buses and vans, funded under Section 147 of the Federal Aid Highway Act of 1973, were conducted on eleven Indian reservations. The evaluations, conducted under the UMTA Service and Methods Demonstration Program, describe the transportation problems in the reservation settings, the benefits and costs of the projects, the solutions to these problems that were demonstrated, and findings and recommendations relative to governmental actions in this area.

5005 **Hydrotransport 6, Volume 1: papers presented at the international conference on the hydraulic transport of solids in pipes, 6th, 1979.** Stephens, H.S. (Ed.); Gittins, L. (Ed.). (BHRA Fluid Eng, Cranfield, Bedford, Engl). **1**: 404(1979).

This conference contains 31 papers, 30 of which are abstracted separately. The subject matter is primarily concerned with the design and related equipment for slurry pipelines. Associated activity such as blast furnace practice and mining methods are discussed. Characteristics of suspensions in fluid flow are analyzed.

5006 **Self-controlling slurry pump developed for the US Department of Energy.** Burnett, M.; Harvey, A.C.; Rubin, L.S. (Foster-Miller Associates, Inc., USA). **1**: 305-314(1979).

A centrifugal pumping device, a helical inducer, has been developed for use in hydrotransport of coarse or fine solids. This centrifugal device is used as a boost pump in slurry lines under conditions of transient flow rates and/or varying slurry concentrations. It operates at a constant speed under these variable conditions which eliminates the requirement for the expensive variable speed drives and controls used on conventional centrifugal pumps. The helical inducer operates with an air core vortex vented to atmosphere in the center of the rotor. The rotor therefore contains an annulus of water and solids turning close to rotor speed. 2 refs.

5007 **Automotive development from an oil company point of view.** Williams, K.R. (Shell International Petroleum Co., Ltd., London, England). pp 125-129 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

The future demand for automotive fuels is examined from the refiner's point of view by considering present demand, the efficiency of the overall vehicle system, the influence of pollution regulations on the types of fuel used, and alternative fuels. (LCL)

5008 **Overall economy of engines and refineries.** Boddy, J.H. (Mobil Oil Co., Ltd, London, England); Spencer, E.H. pp 156-180 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

Review of data available on the overall economy of engines and refineries shows how the interests of two industries are closely interlinked in the objective of using energy in a rational way. Narrowing the field of examination to spark ignition automotive vehicles, it can be shown that environmental constraints impose penalties which may be minimized if engine and refinery designs are interrelated. By co-operative industry tests it is shown that optimum octane quality and engine compression ratio are appropriate to the various possible lead levels which might be imposed. Optimizing engine design and gasoline octane number for 0.15 g Pb/l in 1990, when assumed European gasoline consumption will be 160 Mt/a, would save 2.3 Mt/a of crude oil. The imposition of more stringent emission control standards in the future further emphasizes the need for energy conservation research through cooperative programs involving both car manufacturers and petroleum refiners. (LCL)

5009 **Marine transport.** Anketell-Jones, M.W. (British Petroleum Tanker Co. Ltd., London, England). pp 187-199 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

There is a considerable anxiety in the shipping industry over the qualities of the fuel that may be offered to the industry as the world moves towards an oil deficient situation. This paper discusses the foundations for this anxiety and identifies, from the point of view of the shipping industry, some of the developments that may be required if efficient marine transport is to be maintained.

5010 **Rail transport.** Ribbons, R.T. (British Railways Board, London, England). pp 216-223 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

Without petroleum products British Railways (BR) in its present form could not exist. For not only are trains hauled by diesel engines on 80% of the total route miles but even on the remaining 20% petroleum products are used for lubrication of auxiliary machines, compressors, gearboxes, axles etc. In 1977 BR spent 90×10^6 pounds on petroleum products. This figure is dominated by the cost of fuel for propelling trains, ships and hovercraft. It also includes fuel for heating offices, workshops, hotels, etc., and various types of oil and grease. Although BR spends 90×10^6 £ on petroleum products per year this represents less than 3% of the total transport use. Most of the petroleum products used in the

transport industry are consumed by road vehicles. Comparisons of efficiency between one form of transport and another are difficult to make because of differences in average speeds. However, on a typical motorway journey a passenger car averaging 70 m/h consumes about five times as much fuel per seat mile as a train averaging the same speed. This difference stems from the very low friction between steel wheel and rail, the concentration of railway travel into larger packages, and the relatively clear route available to railways. Although appreciable savings have been and will continue to be made, any saving or reduction in the use of fuel has to at least pay for the cost of making such a reduction. If we are to have serious concern over world reserves of oil, to leave some for our grandchildren, then there is a need for the price to rise in order to enforce the more effective use of petroleum products.

3203 Industry And Agriculture

5011 **(CONF-8006138—1) Analysis of energy use in tomato evaporation.** Rumsey, T.; Conant, T. (California Univ., Davis (USA). Dept. of Agricultural Engineering). 1980. Contract AC07-78CS40141. 17p. NTIS, PC A02/MF A01.

From Summer meeting of American Society of Agricultural Engineers; San Antonio, TX, USA (15 Jun 1980).

Field performance data for four tomato product evaporators are presented and analyzed. Steam and feed flow rates along with steam economies were measured and are compared to steady state theoretical evaporator models.

5012 **(NP—25187(Vol.1)) Study of the potential for cogeneration in Canada: industrial steam turbines. Volume I. Main report.** (Acres Shawinigan Ltd., Toronto, Ontario (Canada)). Dec 1979. 196p. Dep. NTIS (US Sales Only), PC A09/MF A01.

Results of a study to determine the potential for cogeneration in Canada are presented. National, provincial, and industrial potentials for cogeneration based on responses to a questionnaire from 211 plants operating boiler plants are developed. Each of the 211 plants were subjected to a common analysis procedure to determine cogeneration capability and cost. The study defined cogeneration, and addressed the technical potential for cogeneration, the economic implications of cogeneration, and the institutional barriers which have to be overcome before cogeneration is fully accepted as an energy supply option in Canada. (MCW)

5013 **(NP—25187(Vol.2)) Study of the potential for cogeneration in Canada: industrial steam turbines. Volume II. Economic potential.** (Acres Shawinigan Ltd., Toronto, Ontario (Canada)). Dec 1979. 268p. Dep. NTIS (US Sales Only), PC A12/MF A01.

The economic potential, with the identification of the technical possibilities that could prove to be economically viable, for industrial co-generation is discussed. The study takes the point of view of society as a whole and concentrates on what may be thought of as the direct production costs of electric power generation. These are the elements of cost that would fall within the purview of an accountant and it omits the opportunity costs of nonmarket elements. Calculation methods and results of the social savings and price scenarios are presented. Specifically, information on the economic potential of co-generation in Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia is detailed.

5014 **(PB—80-170343) Technical options for conservation of metals: case studies of selected metals and products. Volume II-A: a preliminary assessment of options for reducing wastage of materials. Working Paper No. 1.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jan 1978. 125p. NTIS, PC A06/MF A01.

This assessment deals with options for reducing losses of materials from the domestic materials cycle. Such losses constitute potential wastage where technically and economically feasible ways can be adopted for reducing such losses. The 1974 materials cycles for eight selected metals were studied: iron and steel, aluminum, copper, platinum group metals, manganese, chromium, nickel, and tungsten. The more significant options for reducing losses are as follows: (1) improved solid waste collection, processing, and separation of the metals component; (2) improved identification of the losses from materials cycles; (3) new emphasis on design to facilitate recovery and return to the cycle; (4) research and development on metallurgical processes; (5) substitution of more available materials in selected uses; (6) research and development on milling and concentrating--particularly fine-particle technology.

5015 **(PB—80-170350) Technical options for conservation of metals: case studies of selected metals and products. Volume II-B: flows of selected materials, 1974. Working Paper No. 2.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jan 1978. 211p. NTIS, PC A10/MF A01.

The first task in this assessment was to determine the materials flows for iron and steel, aluminum, copper, chromium, nickel, tungsten, platinum-group metals from their sources (ore) to end-use products. Data were collected on the flow of material in 1974 from source (country) into end-use products with as detailed a classification as was possible with available data. Information on foreign and domestic sources of minerals supply was summarized along with the amounts of secondary metals including prompt and obsolete scrap. In this first task, projections of domestic supply and demand to the year 2000 were also made. In making these longer term projections, major changes in supply technology and major changes in demand technologies were considered. This volume is an edited version of the data collection and analysis on flows of selected basic materials.

5016 **(PB—80-177538) User's manual: coal-mine refuse in highway embankments. Report for Sep 77-May 79.** Pierre, J.J.; Thompson, C.M. (Kimball (Robert L.) and Associates, Ebensburg, PA (USA)). Dec 1979. Contract DOT-FH-11-9355. 206p. NTIS, PC A10/MF A01.

This manual provides the information needed to use coarse anthracite and bituminous wastes in highway embankment construction. It has 2 parts. Part 1 contains wide ranging data needed for an understanding of coal-mine refuse (CMR) properties, its origins, and regulations governing its disposal. Case histories of highway embankments with CMR are included. Part 2--the user's portion of the manual--sets forth the procedures to follow from planning through construction of highway embankments with CMR. The manual will benefit highway and environmental planners, and those engaged in highway design, materials testing, and construction. While geotechnical engineers should be consulted in the design of all highway embankments, the manual contains some elementary geotechnical data for the benefit of those organizations with limited geotechnical skills.

5017 **(STU—77-7289) Analysis of the energy consumption and study of energy conserving measures in foundries.** Stigmarker, H. (Svenska Gjuterifoereningen, Joenkoeping (Sweden)). Sep 1979. 39p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01.

The study was made at 20 iron, steel, and metal foundries. It is concluded that a development of new techniques is necessary to reduce energy consumption, especially in the metal foundries where the efficiencies are very low.

5018 **(STU—78-6895) Development of method and equipment for energy recovery from the exhaust gases of the oil-fuelled smelting and holding furnaces.** Holm, A. (Volvo Flygmotor AB, Trollhaettan (Sweden)). Mar 1980. 14p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01.

A heat recovery system has been tested. The system consists of a flat ceramic heat exchanger and a high-temperature burner for pre-heated combustion air. The fuel saving tests were made with a smelting furnace for aluminum. The furnace can be used as a holding furnace and for a combination of smelting and holding. When the modified furnace is used for holding only, there is 50% reduction of fuel consumption. Combined use renders 30 to 35% saving of fuel. The yearly savings are about 75,000 Skr in this case. Long time tests (about 5000 h) show no change. The equipment can be adapted to various types of oil-fuelled furnaces for smelting, forging, and in the glass industry.

5019 **Energy use in the food manufacturing industry.** Cleland, A.C.; Earle, M.D. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1980). 33p. (NZERDC—54).

A survey was conducted to find the level of energy consumption in the food manufacturing industry, which is the food processing industry excluding meat, dairy, and brewing. Data were used from 74 factories. The manufacturing industry was divided into 14 industry groups and the 4 major energy consumers were found to be fruit and vegetable processing, sugar refining, animal feed production, and bread and pastry baking. The present report summarizes results from the survey. It determined the following: the sources of energy used by the insu industry and the annual consumption of each energy form; the consumption of fuel and electricity in the production of the various manufactured food products; the minimum practical energy requirement for processing the various food products; and the potential for conservation and the methods for achieving savings.

5020 **Engineering study of pelleting waste paper for energy recovery.** Auckland, New Zealand; New Zealand Energy Research and Development Committee (1980). 12p. (NZERDC—53).

Whether the pelleting of selected waste paper to burn as a fuel is commercially viable is investigated. Scientific work completed by the Environmental Ethics Trust is reported. As the production of pellets, the source of raw material, and the burning characteristics have already been established by the Trust, this report concentrates on the economics of production as being one of the two critical factors not yet established. These costs are given for various throughputs to determine the most economic production rate and to establish likely production costs with a given source of raw material. The other critical factor discussed is the possible market for the pellets, for without a market, the economics of the process are meaningless.

5021 **Review of progress to date and future prospects in refinery energy conservation.** Harnett, C.G. (British Petroleum Co. Ltd., London, England). pp 36-51 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

Following the dramatic increase in the cost of crude oil at the end of 1973, BP, in common with other major oil companies, instituted a program designed to identify energy conservation activities throughout its worldwide operations. This paper reviews the progress to date in what is probably the most important aspect of BP's energy conservation activities, namely, refining. The likely trends in refinery energy conservation over the next few years are discussed and an indication is given of the longer term prospects.

5022 **Significance of the use of oil in the chemical industry.** Walker, R.B. (ICI, Petrochemicals Division, Cleveland, England). pp 52-65 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

The chemical industry is essentially a diverse aggregate of individual industries ranging from petrochemicals to pharmaceuticals or from fertilizers to photographic materials. The individual industries operate very different manufacturing processes of varying energy intensity and efficiency. Thus, generalizations may not be valid for all sectors, but what this report attempts to do is to set the UK chemical industry in its context as an energy consumer within the UK and to examine some aspects of how it consumes its energy both as a fuel and as a feedstock. In looking at its use of energy as a fuel the role which petroleum plays and industry's performance and prospects in the field of energy conservation are examined. In looking at the industry's use of petroleum products as a feedstock, this paper attempts to show the manner in which the petrochemical industry can use petroleum feedstocks in an effective fashion at the interface between the refinery and petrochemical manufacture.

5023 **Energy utilization in the iron and steel industry.** Monson, J.R. (British Steel Corp., Cleveland, England). pp 97-111 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

The steel industry is a large consumer of energy and trends in energy costs have caused it to examine carefully the efficiency of energy utilization. Significant reductions in energy consumption have been made in recent years but there is still scope for improvement. The aim of the industry is to reduce input by minimizing unrecoverable losses and to utilize a greater proportion of those which can be recovered. To accomplish fully the latter objective it may be necessary to integrate steelworks more closely with neighbouring consumers and other industries in order to utilize some of the lower grade heat which is generated. As to the future, the classical steelmaking route involving blast furnaces and basic oxygen steelmaking processes would seem to have a potential life well into the next century, although considerable modification, particularly to ferent energy sources changes. The alternative route using direct reduction and arc furnace steelmaking will continue to grow for a limited period, particularly for relatively small unit outputs but its longer term survival must depend upon adaption to the use of coal as a primary energy source. In the very long term steelmaking routes based on hydrogen can be envisaged and these are likely to make considerable demands on electricity as the major energy source.

5024 **(PB—80-166291) Site accounting for waste of materials. Current papers.** Skoyles, E.R. (Building Research Station, Watford (England)). [nd]. 31p. NTIS PC E02/MF E02.

Studies on building sites have shown that waste of materials has a high incidence and that the first priority for understanding and ameliorating the problem should be the provision of an accounting system to enable builders to identify these losses on site while the work is in progress. A simple method has been devised to enable builders to account for materials used on any site, with any form of contract, and to assess the level of waste of each material during the period it occurs. Little extra work is involved. This paper describes the accounting method and illustrates it with annotated figures.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 4621, 4929

5025 **(CONF-801104—10) Production of ammonia in a packed-bed anaerobic upflow (ANFLOW) bioreactor.** Hines, D.C.M.; Weeter, D.W.; Genung, R.K. (Tennessee Univ., Knoxville (USA). Dept. of Civil Engineering; Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 24p. NTIS, PC A02/MF A01.

From 73. annual meeting of the American Institute of Chemical Engineers; Chicago, IL, USA (12 Nov 1980).

Anaerobic upflow (ANFLOW) bioreactors which use fixed films of microorganisms have been considered for alternative wastewater treatment systems. The advantages of this system are presented. The presence of ammonia in the effluent results in a high nitrogenous oxygen demand to receiving waters and is toxic to certain biota at low concentrations. The presence of ammonia in the effluents of wastewater treatment systems must be regulated. Effluent ammonia and ammonia production rates were monitored within the ANFLOW bioreactor as synthetic feed compositions and flow rates were varied. Correlations between influence organic nitrogen loadings and effluent ammonia concentrations were sought. Subsequent ammonia removal methods were proposed. It was demonstrated that ammonia can be easily nitrified with an aerobic upflow biological filter with only 5% of the volume of the ANFLOW bioreactor. Methane production was also measured.

5026 **(PB—80-810278) Regional and urban solid waste disposal: management planning (citations from the NTIS Data Base). Report for 1964-Apr 80.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). May 1980. 278p. NTIS PC N01/MF N01.

Management, state, and local government policies, legislation, financing, data acquisition, and general planning studies for urban and regional solid waste disposal systems are covered. The topics include comments on public health, landfills, pollution, recycling, and load use. Studies on energy recovery and consumption, environmental impacts, land use, guidelines, and models are also covered. (This updated bibliography contains 271 abstracts, 25 of which are new entries to the previous edition.)

5027 **(PB—80-810286) Regional and urban solid waste disposal: local case studies (citations from the NTIS Data Base). Report for 1964-Apr 80.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). May 1980. 248p. NTIS PC N01/MF N01.

Case studies are cited on municipal waste disposal in specific cities, counties, or regions. These studies include aspects of collection, hauling, incineration, sanitary landfills, ocean dumping, and transfer stations as applied to a specific locale. Management studies designed only for these areas are also included. (This updated bibliography contains 241 abstracts, 27 of which are new entries to the previous edition.)

5028 **(PB—80-810294) Regional and urban solid waste disposal: handling and disposal technology (citations from the NTIS Data Base). Report for 1964-Apr 80.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). May 1980. 273p. NTIS PC N01/MF N01.

The citations cover the technology and techniques of collection, hauling, sorting, processing, disposal, incineration, and recycling of urban wastes. These abstracts were chosen to describe methods and equipment for waste handling, disposal, or reclamation. In addition, studies on refuse derived fuels and energy consumption in solid waste processing are covered. (This updated bibliography contains 266 abstracts, 15 of which are new entries to the previous edition.)

5029 **(STU—76-6032) Long time tests of a new PEX tube for hot water transport.** Roseen, R.; Ifwarsson, M. (Styrelsen foer Teknisk Utveckling, Stockholm (Sweden)). Dec 1979. 50p. (In Swedish). (STUDSVIK/E—1-79/161). NTIS (US Sales Only), PC A03/MF A01.

Plastic pipes for hot water transport made of PEX-cross linked polyethene - have been tested for long periods with 80, 95, and 110 Celsius water under pressure.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 5007

5030 **Automotive development from a motor manufacturer's point of view.** Barnard, M.C.S. (Leyland Cars, Warwickshire, England). pp 140-155 of Effective use of petroleum. London, England; Heyden and Son, Inc. (1979).

From Institute of Petroleum annual conference; London, UK (Nov 1978).

The potential improvements in road vehicles and their power units that can be envisaged over the next 25 years in order to conserve fuel against the developing situation of fuel availability and fuel type are considered. The constraining influences of legislation and insistence on reduced nuisance value, particularly within cities, will make transportation needs more difficult to satisfy. Although research will continue on alternative automobile power plants such as gas turbines, Stirling engines, and electrical drive. The impact of these on the overall vehicle fleet is insignificant. It is concluded that car power-plant development will concentrate on the diesel and petrol engines as we now know them. Petrol engine economies will come mainly from raised compression ratio, improved fuel air mixture preparation and better fuel and ignition control. The diesel engine offers less opportunity for improvement in fuel consumption through direct injection combustion may challenge indirect in passenger car applications. Both petrol and diesel engines can be operated with further savings by the use of very high ratio transmissions, which may have to be continuously variable. From the power unit a fuel consumption improvement in the order of 25% is forecast for petrol-powered cars and rather less for diesel. Further savings will come from vehicle weight reduction and reduced drag. (LCL)

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 5008

5031 **(PB—80-170012) Performance characteristics of 1977 General Motors 350 CID engine. Final report.** Boziuk, J. (Department of Transportation, Cambridge, MA (USA). Transportation Systems Center). Feb 1980. 48p. NTIS, PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1977 GM 350 CID engine to determine fuel consumption and emissions (hydrocarbons, carbon monoxide, and oxides of nitrogen) at steady-state engine operating modes. The objective of the test was to obtain engine performance data for estimating fuel consumption and emissions for varied engine service and duty and to provide basic engine characteristic data required for the TSC Vehicle Simulator (VEHSIM).

5032 **(PB—80-175276) Emissions correlations for conventional gas turbines. Final report.** Washam, R.M.; Mellor, A.M. (Purdue Univ., Lafayette, IN (USA). Combustion Lab.). Dec 1977. 85p. NTIS, PC A05/MF A01.

The production of gaseous pollutants from conventional gas turbine combustors is being investigated through the use of a characteristic time model. Here, the dominant subprocesses (liquid fuel evaporation, turbulent mixing, and chemical reaction) affecting the formation and destruction of pollutant species are expressed in terms of times and then sums and ratios of these times are used to correlate emissions. Correlations are done for combustors of three engines (the General Motors GT-309, the Detroit Diesel Allison T-63, and the Pratt and Whitney JT9D); the model predicts the effect of combustor geometry, fuel type, power level, ambient conditions, etc. on the levels of pollutants produced. In addition, the model shows promise as an emissions optimization tool as demonstrated for the GT-309. And, there are indications that, for specific pollutants, universal correlations for all conventional gas turbine combustors can be performed with the model. Generally heterogeneous effects are ignored.

5033 **(SAND—80-8663) Phenomenological description of particulate formation during constant volume combustion.** Dyer, T.M.; Flower, W.L. (Sandia National Labs., Livermore, CA (USA)). Nov 1980. Contract AC04-76DP00789. 40p. (CONF-8010135—3). NTIS, PC A03/MF A01.

From General Motors Research Laboratory conference, particulate carbon: atmospheric life cycle; Warren, MI, USA (12 Oct 1980).

Experiments to characterize soot particulate formation processes during the combustion of rich homogeneous mixtures have been conducted in a constant volume combustion bomb. Soot formation is observed to occur very rapidly in the flame front, and the particles are dispersed over the burned gas region as these gases are continually compressed. Particles sampled and analyzed by transmission electron microscopy exhibit three-dimensional chain-like structures. In the present premixed experiments, any parameter change that increases the flame zone temperature, such as reducing the diluent concentration, decreasing the diluent heat capacity, increasing the initial reactant temperature, or changing the fuel type, reduces the quantity of soot formed. Thus, temperature is shown to be a key parameter in determining the tendency of a mixture to soot. In many of these tests, burned gas temperature is nearly constant with time, suggesting that particulate blackbody radiation may be a stabilizing influence on the burned gas temperature. Coupling this radiation back into the chamber influences the particulate oxidation process and actually reduces the quantity of soot formed.

3303 Electric-powered Systems

5034 **(DOE/JPL/955683—T1) Electric and hybrid vehicle environmental control subsystem study. Final report.** Heitner, K.L. (TRW Energy Systems Planning Div., McLean, VA (USA)). 4 Dec 1980. Contract NAS-7-100-955683. 124p. NTIS, PC A06/MF A01.

The purpose of this study is to select the best technologies for the environmental control subsystem (ECS) for interior heating and cooling in electric and hybrid vehicles. The best technology must be selected from technologies that are available in the near term. The selected technology will serve as a basis on which development of a prototype ECS could start immediately. The technology selected as best ECS for the electric vehicle is the combination of a combustion heater and gasoline engine (Otto cycle) driven vapor compression air conditioner. All of the major ECS components, i.e., the combustion heater, the small gasoline engine, and the vapor compression air conditioner are commercially available. These technologies have good cost and performance characteristics. The cost for this best ECS is relatively close to the cost of current ECS's. At the same time, its effect on the vehicle's propulsion battery is minimal and the ECS size and weight do not have significant impact on the vehicle's range. The required technology also minimizes risk for the vehicle manufacturer because little new capital investment will be needed to produce the ECS. Since electric vehicles are likely to be in limited production for several years, the technology is appropriate for the market size.

5035 **(JPL-PUB—80-69) Aerodynamic design of electric and hybrid vehicles: a guidebook.** Kurtz, D.W. (Jet Propulsion Lab., Pasadena, CA (USA)). 30 Sep 1980. Contract AI01-78CS54209. 87p. NTIS, PC A05/MF A01.

A typical present-day subcompact EHV, operating on an SAE J227a D driving cycle, consumes up to 35% of its road energy requirement overcoming aerodynamic resistance. The application of an integrated system design approach, where drag reduction is an important design parameter, can increase the cycle range by more than 15%. This guidebook highlights a logic strategy for including aerodynamic drag reduction in the design of electric and hybrid vehicles to the degree appropriate to the mission requirements. Backup information and procedures are included in order to implement the strategy. Elements of the procedure are based on extensive wind tunnel tests involving generic subscale models and full-scale prototype EHVs. The user need not have any previous aerodynamic background. By necessity, the procedure utilizes many generic approximations and assumptions resulting in various levels of uncertainty. Dealing with these uncertainties, however, is a key feature of the strategy.

5036 **(LASL—80-45(BRIEF)) Alternative transportation vehicles for military-base operations.** Freiwald, D.A.; Barattino, W.J. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 4p. NTIS, PC A02/MF A01.

Recent petroleum fuel shortages and rapid price increases have stimulated research and development on non-petroleum-derived mobility fuels and nonconventional power sources for ground transportation vehicles. Three alternatives to gasoline- or diesel-fueled engines for military ground transportation vehicles are hydrogen-fueled i.c. engines, electric vehicles, and fuel cell/electric vehicles. Each of these is briefly described. Demonstration programs to evaluate each as a means of reducing petroleum demand for military ground vehicles is recommended. (LCL)

5037 **Vehicle testing of near-term batteries.** Conover, R.C.; Hardy, K.S.; Sandberg, J.J. (Calif Inst of Technol, JPL, Pasadena). *USSAE Preprint (U.S.);* No. 800201, vp(1980).

Vehicle tests of near-term nickel-iron, nickel-zinc, and lead-acid batteries were conducted by the Jet Propulsion Laboratory in support of the Department of Energy's Electric and Hybrid Vehicle Technology Demonstration Program. The tests, which consisted of constant speed and SAE J227a driving cycles, demonstrated significant range improvement relative to current lead-acid batteries, but identified development deficiencies in the near-term batteries. Deficiencies in the state-of-the-art vehicles used for the tests were also identified during the course of testing. 3 refs.

5038 **Electronically commutated motors for vehicle applications.** Echolds, E.F. (AiRes Manuf Co of Calif). *USSAE Preprint (U.S.);* No. 800062, vp(1980).

New electronically commutated traction motors for electric vehicles may offer improved efficiency over a wider load range, lower weight, and potentially lower cost than conventional brush type machines. Two new electronically commutated traction motors are described, along with predicted and measured performance data. The motors are being developed for NASA as part of the Department of Energy electric and hybrid vehicle program.

5039 **System design of the Electric Test Vehicle--One (ETBV-1).** Rowland, E.A.; Schwarze, K.W. (GE, USA). *USSAE Preprint (U.S.);* No. 800057, vp(1980).

The Electric Test Vehicle--One (ETV-1) is a four-passenger electric car developed under sponsorship of the U.S. Department of Energy. Developed as a total system, the ETV-1 incorporates improvements in vehicle design, electronics and battery technology to achieve specified performance, safety and cost objectives. The present test vehicle would be suitable, with further development, to be mass-produced by the mid-1980's. Performance of the ETV-1 is enhanced by lightweight construction, low aerodynamic drag, and low rolling resistance. Efficiency of the electrical drive subsystem is optimized through the use of a separately excited drive motor with transistorized armature and field controls. An improved lead-acid battery is used to provide high energy and power density. 4 refs.

5040 **Drive system of the DOE near-term Electric Vehicle (ETV-1).** Wilson, J.W.A. (GE, Schenectady, NY). *USSAE Preprint (U.S.);* No. 800058, vp(1980).

This paper describes the dc, separately excited, motor drive system of the DOE-General Electric-Chrysler Electric Test Vehicle (ETV-1) recently developed under U.S. Department of Energy sponsorship. Engineering details of all the major drive system components, including the motor armature, field controllers, and the microprocessor-based propulsion controller, are given with appropriate design and test results. 5 refs.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 5034, 5035, 5036

5041 **Trade-off results and preliminary designs of near-term hybrid vehicles.** Sandberg, J.J. (Calif Inst of Technol, JPL, Pasadena). *USSAE Preprint (U.S.);* No. 800064, vp(1980).

Phase I of the Near-Term Hybrid Vehicle Program involved the development of preliminary designs of electric/heat engine hybrid passenger vehicles by four contractors. The preliminary designs were developed on the basis of mission analysis, performance specification, and design trade-off studies. The resulting designs all involve parallel hybrid (heat engine/electric) propulsion systems but provide significant variation in component selection, power train layout, and control strategy. Each of the four designs is projected by its developer as having the potential to substitute electrical energy for 40% to 70% of the petroleum fuel consumed annually by its conventional counterpart. 5 refs.

3307 Emission Control

REFER ALSO TO CITATION(S) 5045

5042 **(PB—80-166085) Hydrocarbon formation and oxidation in spark-ignition engines. Volume I: summary. Final report, Sep 76-Aug 79.** Heywood, J.B.; Keck, J.C.; Rife, J.M. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jan 1980. 44p. NTIS, PC A03/MF A01.

This report summarizes the key results and conceptual findings from a three-year research program on hydrocarbon formation and oxidation mechanisms in spark-ignition engines. Research was

carried out in four areas: laminar flame quenching experimental and analytical studies; quench layer studies in a spark-ignition engine using a rapid acting gas sampling valve; flow visualization studies in a transparent engine to determine quench layer and quench crevice gas motion; studies of heat transfer, mixing and HC oxidation in the exhaust port. More detailed descriptions of the individual research activities in these areas can be found in the theses and publications completed to date which form Volumes II to XI of the final report of this program.

5043 (SNV-PM—1253) Issues related to control of exhaust emissions from automobiles in Sweden. Stork, E.O. (Statens Naturvaardsverk, Stockholm (Sweden)). 1979. 72p. NTIS (US Sales Only), PC A04/MF A01.

Sweden should deal separately with the largely-independent questions of the stringency of automotive emission standards and how to assure compliance with standards. The current studies of the need for emission control in Sweden should be completed before emission standards are revised. The current Swedish compliance assurance program is not effective. An alternative approach is needed. The most promising alternative would involve manufacturers having to pay emission fees when mean emissions from classes of their cars in actual use exceed the standards. The compliance of in-use vehicles with emission standards is a difficult problem for which no satisfactory solutions are available. The most promising approach is to require manufacturers to build cars that cannot be easily maladjusted. The Environment Protection Board's resources for the conduct of an automobile emission compliance program are wholly inadequate. If Sweden is to have confidence that it obtains the clean-air benefits for which its citizens pay when they buy new cars, the Board's staff assigned to automotive emission control work needs to be strengthened.

3308 Alternative Fuels

5044 (LA—8605-MS) Liquid-hydrogen-fueled Buick. Stewart, W.F. (Los Alamos Scientific Lab., NM (USA)). Nov 1980. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01.

A 1979 Buick Century sedan with a 3.8-l (231-in.^{3}) displacement turbocharged V-6 engine and automatic transmission was converted to operation on hydrogen supplied to the engine from a liquid-hydrogen tank installed in the trunk of the car. The liquid-hydrogen tank is refilled using a semi-automatic refueling station designed to be operated by personnel with minimal training. The Buick has a fuel economy corresponding to 8.9 km/l (21 miles/gal.) of gasoline and a range of 274 km (170 miles) in the high altitude area of Los Alamos, New Mexico.

5045 Driving cycle economy, emissions and photochemical reactivity using alcohol fuels and gasoline. Bechtold, R.; Pullman, J.B. (US DOE). *USSAE Preprint (U.S.);* No. 800260, vp(1980).

An oxidation catalyst equipped vehicle and several three-way-catalyst (TWC) equipped vehicles were modified to operate on the Federal Test Procedure using gasoline or alcohol fuels. Photochemical reactivity comparisons of unburned fuel emissions were made by calculation and also with a 100 cu. ft. smog chamber. Synthetic reproductions (surrogates) of stoichiometric methanol exhaust were less photochemically reactive than gasoline exhaust surrogates for the 8.5:1 compression ratio engine conditions. This effect was observed even though methanol exhaust surrogates were tested at higher hydrocarbon-to-NO/sub x/ ratios (20:1 vs. 13.8:1) than were the gasoline exhaust surrogates. 28 refs.

36 MATERIALS

REFER ALSO TO CITATION(S) 4426, 4791, 4962

5046 (BNL—28634) Beneficiation of natural aggregates by polymer impregnation. Webster, R.P.; Fontana, J.J. (Brookhaven National Lab., Upton, NY (USA)). Sep 1980. Contract AC02-76CH00016. 15p. (CONF-801220—1). NTIS, PC A02/MF A01.

From ASTM symposium on extending aggregate resources; Orlando, FL, USA (10 Dec 1980).

The use of polymer impregnation as a means of upgrading natural aggregates has been investigated. The effect of polymer impregnation on the physical and mechanical properties was evaluated in a series of tests performed using four aggregates of varying quality. The strength of concrete cast with polymer impregnated coarse aggregate was also tested. Two monomer systems were used in the investigation; a methyl methacrylate-based system and a styrene-based system. In general, significant improvements in the physical and mechanical properties of each of the four aggregates resulted from polymer impregnation. The strength of concrete cast with impregnated aggregates varied, being increased in some cases and decreased in others.

5047 (GEPP-TIS—540) Resistance projection welding of vacuum tube getter assembly. Kuncz, F. Jr. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 10 Dec 1980. Contract AC04-76DP00656. 13p. NTIS, PC A02/MF A01.

Tungsten inert gas welding the leads to a vacuum tube getter assembly can result in fusion of gettering powder, lowering gas absorption capability. Using resistance projection welding with ball-ended leads, getter bodies were successfully bonded to the leads. Special electrodes were designed. Materials and methods are given for producing ball-ended leads, designating and building special electrodes, and for welding the leads to the body.

5048 (GEPP-TIS—543) Resistance projection welding small pins in vacuum tube feedthrough assembly. Kuncz, F. Jr. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 10 Dec 1980. Contract AC04-76DP00656. 13p. NTIS, PC A02/MF A01.

Resistance projection welding of two stainless steel pins to a cup is successfully accomplished by specially designed electrodes and by forming domes on the pin ends. Details of electrode and pin construction are given, as well as welding parameters.

5049 (LBL—9779(Rev.)) Direct imaging of grain boundaries. Gronsky, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 59p. (CONF-7909100—3(Rev.)). NTIS, PC A04/MF A01.

From American Society of Metals seminar; Milwaukee, WI, USA (15 Sep 1979).

There are currently two types of microscopes which, in principle, are capable of imaging atom positions at grain boundaries. One, the field ion microscope (FIM), yields a projection of the specimen surface (approximately stereographic) by field ionization of an imaging gas at protruding atom sites, and provides topographic information in high-index pole regions which may be interpreted atom-by-atom. The other, a transmission electron microscope (TEM), yields a projection (approximately linear) of the entire specimen thickness by electron optical imaging, and provides atomic resolution detail throughout the illuminated area. In this paper, both methods are described and compared, using examples from practical materials systems.

5050 (LBL—11335) Wetting, spreading and reactions at liquid/solid interfaces. Pask, J.A.; Tomsia, A.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 15p. (CONF-800765—4). NTIS, PC A02/MF A01.

From 7. LLR/MMRD international symposium of interfaces in glass-metal systems; Berkeley, CA, USA (28 Jul 1980).

Chemical (thermodynamic) stable equilibrium at glass-metal interfaces is established when the liquid glass becomes saturated with the low valence oxide of the metal. Stable or metastable equilibrium conditions at glass-metal interfaces result in a constant contact angle in a sessile drop experiment. If chemical equilibrium is absent, then a driving force exists for the occurrence of a reaction to attain equilibrium. All reactions that take place contribute to the maintenance of the necessary saturation of the liquid and solid at the interface with the solid substrate oxide in order to realize chemical bonding across the interface. Spreading always occurs when the solid metal is an active participant in these reactions. Examples showing the development of these principles are based on

systems of sodium disilicate with Fe, Co, Ni, Fe-Ni alloys, Pt, Ag, Au, Cu, Ta, W, Mo, Nb, Zr, and Cr. The final structure and composition of the glass-metal interfacial zone are determined by the kinetics and thermodynamics of the reactions that occur.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 4424, 4427, 4428, 4430, 4431, 4432, 4433, 4434, 4435, 4436, 4437, 4438, 4440, 4441, 4442, 4452, 4463, 4561, 4571, 4571, 4741, 4742, 4743, 4744, 4746, 4747, 4752, 4758, 4792, 4853, 4896, 5157, 5161, 5196, 5197, 5198, 5199, 5200, 5549, 5593

5051 (BNL—28632) Crystalline electric fields in mixed valent systems. Shapiro, S.M. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 15p. (CONF-801134—11). NTIS, PC A02/MF A01.

From 26. annual conference on magnetism and magnetic metals; Dallas, TX, USA (11 Nov 1980).

The inelastic neutron studies of rare-earth-based mixed valent systems have all shown remarkably similar results: a broad quasielastic line with half width on the order of 10 MeV. This width exhibits a strong temperature dependence in those systems which undergo a valence transition and is only weakly temperature dependent in those systems which show no transition. A surprising result was the absence of crystalline electric field (CEF) excitations. Recent measurements on the alloy Ce/sub .9-x/La/sub x/Th/sub .1/ have revealed the existence of CEF excitations. For $x = 0$, the valence transition is strongly first order and occurs near $T_0 \sim 150$ K. The inelastic spectra exhibit the typical broad quasielastic scattering. As x increases, T_0 decreases due to internal pressure effects, and a well-defined, but broad, excitation appears near $E = 15$ MeV. This is interpreted as a CEF excitation between the Γ_7 and Γ_8 levels of the Ce^3+ ion. For $x = 0.40$, the valence transition is almost completely suppressed and the excitation becomes even sharper.

5052 (CALT—822-101) Magnetic cluster mean-field description of spin glasses in amorphous La-Gd-Au alloys. Poon, S.J.; Durand, J. (California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). Mar 1978. Contract AC03-76ER00822. 52p. NTIS, PC A04/MF A01.

Bulk magnetic properties of splat-cooled amorphous alloys of composition La/sub 80-x/Gd/sub x/Au_{20} ($0 \leqq x \leqq 80$) were studied. Zero-field susceptibility, high-field magnetization (up to 75 kOe) and saturated remanence were measured between 1.8 and 290°K. Data were analyzed using a cluster mean-field approximation for the spin-glass and mictomagnetic alloys ($x \leqq 56$). Mean-field theories can account for the experimental freezing-temperatures of dilute spin-glasses in which the Ruderman-Kittel-Kasuya-Yosida interaction is dominant. For the dilute alloys, the role of amorphousness on the magnetic interactions is discussed. By extending the mean-field approximation, the concentrated spin-glasses are represented by rigid ferromagnetic clusters as individual spin-entities interacting via random forces. Scaling laws for the magnetization M and saturation remanent magnetization M/sub rs/ are obtained and presented graphically for the $x \leqq 32$ alloys in which $M/x = g(H/x^*, T/x)$, M/sub rs/(T)/x = M/sub rs/(0)/x/ exp (-α^*T/x/sup p/) where x^* is the concentration of clusters, α^* is a constant, and p is the freezing-temperature exponent given by T/sub M/ $\propto$ x/sup p/. It is found that $p = 1$ and 1.3 for the regions $4 \leqq x \leqq 40$ respectively. An attempt is also made to account for the freezing temperatures of concentrated spin glasses. The strength of the interaction among clusters is determined from high-field magnetization measurements using the Larkin-Smith method modified for clusters. It is shown that for the $x < 24$ alloys, the size of the clusters can be correlated to the structural short-range order in the amorphous state. More concentrated alloys are marked by the emergence of cluster percolation.

5053 (CONF-801079—, pp III.12-III.19) **Microstructural effects in abrasive wear.** Fiore, N.F.; Kosel, T.H. (Univ. of Notre Dame, IN). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

This research is aimed at establishing quantitative relations between microstructure and wear resistance for highly alloyed white irons and Co-base powder metallurgy (PM) alloys commonly used in coal mining, handling and conversion processes. The objective has both basic and applied aspects. On the applied side, a better understanding of the physical and mechanical metallurgy of wear is leading to the semiempirical development of abrasion-resistant alloys of minimal alloy content and heat treatment requirements. On the basic side, understanding of the micro-flow and micro-fracture processes in abrasion is defining the role of such parameters as second-phase size and hardness in wear and is providing the means of alloy design from first principles. This two-faceted objective is being approached by means of combined metallographic analysis and wear testing. The metallographic analysis, which includes automated quantitative metallography, is directed toward establishing quantitative, although perhaps empirical, relations between wear mechanisms and such microstructural parameters as second-phase size, size distribution, shape, orientation and hardness. The wear testing is conducted on laboratory rubber-wheel abrasion and gouging abrasion test systems which have been correlated to field experience, on a single-point scratch test system which is useful for basic studies.

5054 (CONF-801079—, pp III.20-III.28) **Wear-resistant materials for coal conversion components.** Kelley, J.E.; Leavenworth, H.W. Jr. (Bureau of Mines, Albany, OR). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The program is divided into three major areas of research: laboratory wear testing and evaluation of potential wear-resistant materials, production of hardware and components for evaluation in full scale test facilities or coal conversion plants, and provision of wear data, materials selection advice, and consultation to other laboratories, valve manufacturers, and coal conversion plant personnel. Wear-testing is done in three laboratory test facilities. Evaluation of the solid-particle erosion resistance of materials is done with an inert-gas propelled stream of -27μm Al_2O_3 particles. Abrasion wear and galling are evaluated in a Falex No. 6 thrust-washer testing machine to simulate the rubbing action of an unlubricated ball valve operating in an abrasive environment. The third test is a fullscale evaluation of a 6-inch ball valve in hot coal-ash. Lifetime tests of 20,000 open-close cycles are being made on experimental ball and seat materials. For the production of valve hardware and components, a study of laser-processing of wear-resistant thermal-spray coatings for application to ball-valve seats has been made.

5055 (CONF-801079—, pp III.29-III.32) **Fossil energy welding and cladding program.** Goodwin, G.M.; Edmonds, D.P. (Oak Ridge National Lab., TN). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of this task is to develop economical and reliable techniques for cladding and welding critical components of coal conversion and coal utilization systems and to help evaluate and characterize heavy-section weldments. The present designs of coal conversion and coal utilization systems present a number of fabrication challenges. An area of concern is development of field welding techniques for some of the large pressure vessels for coal conversion. The large vessels for gasification will require field fabrication. Liquefaction vessels will be partially shop fabricated with the components being finally assembled in the field. We are investigating cladding techniques and processes applicable to both field and shop fabrication. These methods will produce cladding and base metal microstructures which have been optimized for corrosion resistance. In addition, we are characterizing and evaluating heavy-section submerged-arc (SA) weldments (0.3 m thick) in 2 1/4 Cr-1 Mo steel, which are similar to those anticipated for coal conversion.

5056 (CONF-801079—, pp III.40-III.43) **Development of automated welding processes for field fabrication of thick-walled pressure vessels - electron beam method.** Weber, C.M. (Babcock & Wilcox Co., Alliance, OH). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Field fabrication of coal gasification vessels will be required due to shop and transportation limitations for these large vessels. Electron beam welding is a welding process that potentially could reduce the field fabrication costs. In comparison to existing field

welding processes (shielded metal-arc welding), the rate of welding 8" thick 2-1/4 Cr-1 Mo material in the horizontal position is about 200 times faster. The objective of this project was to develop and demonstrate an electron beam welding procedure for welding 8" thick SA387 Grade 2 (2-1/4 Cr-1 Mo) material in the horizontal position acceptable to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 2. In addition to the work necessary to accomplish the objective, work was performed to acquire information relative to the feasibility of electron beam welding coal gasification units. Considerable difficulty was encountered in developing the welding procedures for making defect-free prtial penetration electron beam welds. Fusion zone voids, porosity, and cracks were observed and techniques were developed which eliminated their occurrence.

5057 (CONF-801079—, pp III.48-III.52) **Fatigue crack growth in low alloy pressure vessel steels.** Ritchie, R.O. (Massachusetts Inst. of Tech., Cambridge). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of this research is to examine mechanical, metallurgical, and environmental factors which influence sub-critical crack growth in candidate low alloy steels for potential coal conversion pressure vessel applications. Particular emphasis is placed on ultralow, near-threshold, fatigue crack propagation in thick section 2 1/4 Cr-1 Mo steels and weldments, tested in gaseous hydrogen and simulated gasifier environments. Parallel studies are centered on defining basic mechanisms for such environmentally-assisted crack growth (corrosion fatigue), specifically with reference to the role of gaseous hydrogen in influencing fatigue crack growth in both lower strength 2 1/4 Cr-1 Mo steels and ultra-high strength 4340 steels. The major enhancement in crack propagation rates due to the presence of hydrogen gas can be seen below 5×10^{-6} mm/cycle where growth rates in hydrogen are as much as two orders of magnitude greater than in air.

5058 (CONF-801079—, pp III.53-III.58) **Analysis of hydrogen attack on coal conversion vessels.** Odette, R.; Vagarali, S.; Oldfield, W. (Univ. of California, Santa Barbara). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Steels in coal conversion vessels are exposed to hydrogen at high temperatures and pressure (T ~ 450°C amd P/sub H2/ ~ 15 MPa). Under these conditions hydrogen readily diffuses into the metal matrix and reacts with carbon at internal surfaces to form methane. This phenomenon, known as hydrogen attack (HA), results in internal decarburization and the nucleation, growth and eventual coalescence of grain boundary cavities; these microstructural changes, in turn, result in severe degredation of mechanical properties. Selection of safe hydrogen pressure and temperature limits has been based on the empirical Nelson Curve; these curves have been developed for various broad alloy classes and qualitative failure criteria. However, because of extremely limited data and operating experience under the conditions pertinent to coal conversion technologies, and probable requirements for fail-safe operation, Nelson curves do not appear to be adequate for designing thick-walled pressure vessels. The purpose of this research is to develop physical models of the HA process describing important mechanisms and containing pertinent environmental and metallurgical parameters. These models are then used to correlate statistically engineering and laboratory data, and to extrapolate the data to predict HA behavior under actual vessel service conditions.

5059 (CONF-801079—, pp III.59-III.64) **Hydrogen attack in Cr-Mo steels at elevated temperatures.** Li, C.Y. (Cornell Univ., Ithaca, NY). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of this program is to determine the kinetics of nucleation and growth of methane bubbles or cavities in 2 1/4 Cr-1 Mo steels (primarily ASTM 387) at elevated temperatures under the influence of high pressure hydrogen and applied stress and to develop kinetic equations for estimating the number density and size distribution of grain boundary cavities as a function of time under conditions of interest to coal conversion plant operations. In Task I steel specimens are exposed to high pressure hydrogen up to 2000 psi at elevated temperatures (450 to 600°C) in autoclaves with or without an applied stress. In Task II, growth experiments are performed under an applied stress at elevated temperatures (450 to 600°C) with specimens with or without prior hydrogen exposure. A limited number of growth experiments are performed under both an applied stress and high pressure hydrogen at elevated tempertures (450 to 600°C).

5060 (CONF-801079—, pp III.65-III.66) **Program to optimize Cr-Mo steels to resist hydrogen and temper embrittlement.** Shaw, B.J. (Westinghouse Electric Corp., Pittsburgh, PA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

This program is an investigation to evaluate and optimize the resistance to hydrogen and temper embrittlement susceptibility of chromium-molybdenum steels for use as structural materials in coal-conversion pressure vessels. Phase I concentratest on the degradation of properties of commercial 2-1/4 Cr-1 Mo steel due to the effects and interactions of hydrogen and temper embrittlement. Phase II is an investigation of the effect of composition and strength level with the intention of establishing compositions with a maximum resistance to both embrittlement effects. The embrittlement susceptibility of weld heat-affected zones (HAZ) is of particular interest to the study. In Phase I of the study, tests on commercial 2-1/4 Cr-1 Mo steels are underway to establish the hydrogen embrittlement susceptibility in 50 psig H_2S. The effect of strength level, up to the peak strength level in the HAZ, is included. In Phase II the effect of composition and strength level on temper embrittlement and hydrogen embrittlement susceptibility will be established for 32 laboratory heats. The compositions of these heats are organized according to a statistical design so that the role of Mo, Cr, Mn, Si, C, and P will be determined via regression and analyses.

5061 (CONF-801079—, pp III.67-III.74) **Characterizing and improving the toughness of thick-sectioned 2 1/4-Cr-1Mo electroslag weldments.** Edwards, G.R.; Frost, R.H. (Colorado School of Mines, Golden). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Electroslag welding, wherein large single-pass welds are made by consuming a wire electrode in an ohmically heated flux pool, has been a particularly appealing process for thick-section welding because of the high deposition rate. Application of the process is currently hindered, however, by lack of a fundamental understanding of the critical process variables. Careful control of the potential, the electrode composition and velocity, and the flux composition are all critical to fabrication. The post-weld heat treatment strongly affects the final mechanical properties of the weldment, especially in 2 1/4 Cr-1Mo steel. The objective of this program is to characterize the effects of the process variables stated above, and to apply that knowledge in optimizing the properties of 4-in.-thick 2 1/4Cr-1Mo electroslag weldments. Research efforts have been focused on three areas: 1) a more complete understanding of process control, 2) a study of the effects of post-weld stress-relief heat treatment, and 3) an experimental analysis of electrochemical processes in electroslag welding.

5062 (CONF-801079—, pp III.75-III.78) **Shielding gas composition and electrode geometry influence on arc properties.** Key, J.F. (EG & G Idaho, Inc., Idaho Falls). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Addition of significant amounts of helium to argon shielding gas causes a gas tungsten arc to be a broader, more isothermal, heat source than an arc shielded with pure argon. Blunt electrode tip geometries, compared to sharp ones, tend to cause flatter temperature distributions in pure argon but have temperature distributions similar to sharp electrode tips in moderate to high helium environments. Thermophysical properties of the shielding gas constituents appear to have greater influence on fusion zone profile than does arc temperature. However, refined heat transfer models of the future will require arc temperature distributions as a function of essential welding variables since these models will use properties which are strongly temperature dependent.

5063 (CONF-801079—, pp III.79-III.82) **Welding research.** Smartt, H.B. (EG & G Idaho, Inc., Idaho Falls). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

This work is a systematic experimental study of the effects of filler wire addition on weld bead geometry for partial penetration bead-on-plate gas tungsten arc welding of stainless steel.

5064 (CONF-801079—, pp III.83-III.92) **Manufacturing technology for improved low-cost electroslag cast materials and components for application in coal conversion.** Bhat, G.K. (Carnegie-Mellon Univ., Pittsburgh, PA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Program objectives are to determine: (a) the economics, (b) the technical factors which define the value of using electroslag casting as a means of fabricating components of coal conversion equipment. Electroslag cast shapes of mild steel (type ASTM A106) will be manufactured under a subcontract to World Metals, which will use an industrial size electroslag melting facility available at Champion Steel Company, Orwell, Ohio. Metallurgical and mechanical property evaluations of electroslag cast components produced in this project will be primarily done by the industrial users. In this case, Elliott Company, a Division of Carrier Corporation, and Champion Steel Company will be the principal evaluators. Other users who have expressed interest in participating in the casting evaluation program include Babcock and Wilcox Company, Exxon Research and Engineering Inc. Several design concepts relative to the construction of mold, mandrel, stool and the electrode holder were evaluated in great detail and refined so as to arrive at simple, low cost special tooling. These tooling items will be further evaluated during the electroslag casting process developmental studies.

5065 (CONF-801124—34) **Laser induced defects and materials interactions in the V-Si system.** Appleton, B.R.; Stritzkner, B.; White, C.W.; Narayan, J.; Fletcher, J.; Meyer, O.; Lau, S.S. (Oak Ridge National Lab., TN (USA); California Univ., San Diego, La Jolla (USA)). 1980. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

Pulsed laser annealing has been evaluated as a technique for fabricating superconducting V_3Si from multilayer V-Si samples, and the nature of laser-induced defects in V_3Si single crystals has been examined. Correlated analyses by ion scattering, ion channeling, T/sub c/ measurements and TEM were used to examine the composition and structure of samples subjected to single and multiple laser pulses. It was observed that although the superconducting A15 phase could be formed by pulsed laser mixing, the associated rapid quenching effects introduced defects which were not completely removed by thermal annealing to 925 K for 1 hour. Ion channeling and TEM studies of V_3Si single crystals showed that pulsed laser irradiation caused microcracks to develop in the surface, probably from mechanical stresses induced by thermal gradients.

5066 (COO—2422-28) **Materials and mechanics of rate effects in brittle fracture. Progress report, October 1979-October 1980.** Burns, S.J. (Rochester Univ., NY (USA)). 1980. Contract AS02-76ER02422. 16p. NTIS, PC A02/MF A01.

Energy balance methods have been used to find the crack driving force in elastic fractures. The fracture toughness of cracked steel bars have been measured using these techniques. Crack tip dislocations have been shown to protect the crack tip by having a stress intensity value that is opposite in sign from the applied stress intensity value. Thus, crack tip dislocation plasticity shields the crack from the external stress intensity factor. In the fatigue of LiF single crystals a relationship between monotonic and fatigue hardening responses has been established using a statistical model for fatigue deformation.

5067 (COO—4725-5) **Kinetics of the desulfurization of molten iron. Progress report, March 1-October 1, 1980.** Gaskell, D.R. (Pennsylvania Univ., Philadelphia (USA)). Oct 1980. Contract AS02-78CS40153. 5p. NTIS, PC A02/MF A01.

The rate of desulfurization of liquid iron by liquid CaO-saturated CaO-FeO has been measured at 1600°C. The initial oxygen content of the iron is that which is in equilibrium with the slag at 1600°C and the experimental observation that the oxygen content of the metal does not vary with time indicates that the coupled reactions occurring are [S]/sub metal/ + $2e^- \rightarrow (S^{2-})$/sub slag/ and [Fe]/sub metal/ $\rightarrow (Fe^{2+})$/sub slag/ + $2e^-$. The rate of desulfurization is controlled by diffusion of sulfur in the metal. The observed initial stage of rapid desulfurization is due to interfacial tension-induced local turbulence at the interface. Work is continuing on study of the rate of desulfurization of liquid iron by CaO-saturated FeO-CaO containing CaF_2.

5068 (DOE/ER/05111—3) **Microstructural studies of hydrogen and deuterium in bcc refractory metals.** Moss, S.C. (Houston Univ., TX (USA). Dept. of Physics). 1980. Contract AS05-76ER05111. 14p. NTIS, PC A02/MF A01.

Over the past four years this research has been principally concerned with uncovering the microstructural atomic arrangements in alloys of hydrogen and deuterium with bcc refractory metals. Because these are interstitial phases in which the host metal lattice is substantially deformed by the incorporation of the H(D) atoms, there are pronounced x-ray scattering effects. X-ray diffraction has, therefore, been the main structural tool. A main objective of the project has been to determine the degree to which phase relations and solid solution properties in metal-hydride alloys depend upon the hydrogen-hydrogen interaction via the displacement field of the metal atoms. This has often included the elucidation of subtle thermodynamic properties which are revealed in structural studies.

5069 (DOE/OR/13513—T1) **Evaluation of hydrogen embrittlement in Cr-Mo pressure vessel steels. Topical report No. 1.** Shaw, B.J.; Johnson, E.W. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 24 Aug 1980. Contract AC05-78ET13513. 22p. NTIS, PC A02/MF A01.

Commercial 2 1/4 Cr-1 Mo low strength steel specimens were tested to measure their susceptibility to hydrogen embrittlement in an environment of H_2S at 50 psig. The plane stress zones on the crack front in compact tension specimens and incubation time effects seriously confounded measurements on these steels when tested by conventional rising load experiments. Because of the incubation time effect, K/sub or/ (the stress intensity at which cracking starts in a rising load test) is a loading rate dependent variable and is usually significantly greater than the arrest stress intensity, K/sub arr/ in a bolt loaded test. K/sub arr/ must therefore be used as a measure of hydrogen resistance. The incubation time has been significantly reduced by cyclicly loading in the environment to initiate the crack and K/sub arr/ has been measured by holding the specimen in constant displacement immediately after crack initiation. The plane stress problem has been eliminated by deeply side grooving the compact tension (CT) specimens. As as example of the importance of these effects a 3T CT smooth sided specimen was compared with a side grooved 2T CT specimen of the same steel. Whereas the K/sub or/ value for the smooth 3T was approximately 150 ksi in/sup 1/2/ the K/sub arr/ value for the side notched 2T was approximately 20 ksi in/sup 1/2/. A study of the effect of strength level is included.

5070 (HEDL-SA—2188) **Hydrogen permeability through rhenium and a molybdenum/rhenium alloy with and without a CVD tungsten coating.** Svedberg, R.C.; Bowen, W.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1980. Contract AC14-76FF02170. 14p. (CONF-800439—13). NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (21 Apr 1980).

The measured permeation rates for the five samples tested are described by equations (in units of torr.liter.$cm^{-1}.s^{-1}$.torr/sup -1/2/).

5071 (LA—8517-MS) **Casting procedure for barium metal cones used in high-altitude experiments.** Manker, L.F. Jr. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

A casting method has been developed for the fabrication of barium cones. This method, employing graphite that is machined

and treated, produces a mold to make barium cones for use in diverse high-altitude atmospheric experiments.

5072 **Amorphous magnetic rare earth alloys. Chapter 16.** Rhyne, J.J. (National Bureau of Standards, Washington, DC (USA). Inst. for Materials Research). pp 259-294 of Handbook on the physics and chemistry of rare earths. Vol. 2. Alloys and intermetallics. Gschneider, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). Amsterdam, Netherlands; North-Holland (1979).

The structure and properties of amorphous magnetic rare earth alloys are discussed, particularly the RFe_2 alloys.

5073 **(ORNL/TM—7554) Effect of microstructure on the susceptibility to hydrogen attack.** Williams, R.O. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01.

We analyzed how the departure from internal equilibrium in low-alloy steels is associated with a variable carbon activity. This is perceived to be of considerable importance in the susceptibility of such steels to hydrogen attack. Solving this problem has three parts. First, one must have an adequate thermodynamic description of the phases in coexistence. Second, one must be able to calculate the carbon activity as a function of the degree of partitioning of the alloy additions to the carbide phases. Finally one must be able to calculate the kinetics of the partitioning. According to the presently available information, these problems apparently can be solved analytically with a useful level of precision.

5074 **(PB—80-167018) Mechanism of SO_2 and H_2SO_4 aerosol zinc corrosion. Final report, 9 May-9 Jun 79.** Harker, A.B.; Mansfeld, F.B.; Strauss, D.R.; Landis, D.D. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Jan 1980. Contract EPA-68-02-2944. 42p. NTIS, PC A03/MF A01.

This study established the physical variables controlling the SO2 and H2SO4 induced corrosion of zinc. Relative humidity, temperature, air flow velocity, flow turbulence, aerosol size range, and pollutant concentration were controlled. Corrosion measurements were made through the use of an atmospheric corrosion monitor. The results showed that the principal factors controlling pollutant induced corrosion are relative humidity, the rate of pollutant flux to the surface, and the chemical form of the pollutant. SO2 was observed to induce a higher corrosion rate in the zinc than H2SO4 on a molecule for molecule basis. Flow dynamic measurements provided bulk and size detailed deposition velocities for two different accumulation mode H2SO4 aerosol size distributions as a function of frictional velocity, and a deposition velocity for SO2 gas. The overall results indicate that under most ambient conditions SO2 induced corrosion damage will dominate over H2SO4 effects.

5075 **(PB—80-170475) Effect of neutron irradiation on sequential creep-fatigue interaction of ^{18}Cr-^{11}Ni (DIN 1.4948) stainless steel plate and welded joints at 823 K.** Schaaf, B.v.d.; de Vries, M.I.; Elen, J.D. (Netherlands Energy Research Foundation, Petten). Oct 1979. 102p. NTIS, PC A06/MF A01.

Neutron fluence amounted to 10 to the 23rd power n.1/sq m (E>0.1 MeV). Creep exposures lasted up to 4100 h. Low cycle fatigue testing was carried out with a total strain range of 0.6% and a strain rate of 3* 1/1000/s. The data are required for design and safety analysis of permanent structures such as: reactor vessel and shield tank of the fast breeder reactor SNR-300. With increasing creep damage prior to fatigue the number of fatigue cycles to failure is decreasing. For parent metal the fatigue fraction of 0.5 is not exceeded, due to the early initiation of fatigue cracks at intergranular creep cracks. The creep cracks serving as starter cracks for fatigue in welds are formed in or near the root bead. With increasing fatigue damage prior to creep the times to rupture are increasing up to fatigue fractions of 0.5. After higher fatigue fractions the times to rupture rapidly decrease. In the irradiated condition the creep stresses needed to accumulate a certain amount of creep damage in a certain time are 50 MPa lower than in the unirradiated condition. For welded joints the amount is 30 MPa. Creep ductility after irradiation is decreased by a factor 5.

5076 **(PB—80-810013) Pipeline corrosion (citations from the NTIS Data Base). Report for 1964-Apr 80.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). May 1980. 221p. NTIS PC N01/MF N01.

Federally-sponsored research on pipeline corrosion in soils, sea water, and fresh water are covered. Studies include pipeline systems containing natural gas, petroleum, slurries, water, and volatile or corrosive liquids. Materials for pipelines are discussed as well as inhibitors for pipeline systems. Coatings, linings, welding, and testing are described as they relate to corrosion. (This updated bibliography contains 214 abstracts, 69 of which are new entries to the previous edition.)

5077 **(PB—80-810021) Pipeline corrosion (citations from the Engineering Index Data Base). Report for 1977-Apr 80.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). May 1980. 243p. NTIS PC N01/MF N01.

Worldwide research is cited on corrosion and corrosion prevention of pipelines for natural gas, petroleum, water, slurries, and other gases and liquids. Pipes of steel, stainless steel, copper alloys, galvanized steel, concrete, and zinc alloys are the major materials studied. Prevention of corrosion by cathodic protection, coatings, wrappings, and linings are covered. The use of plastics for corrosion resistant pipes is included. (This bibliography contains 236 abstracts, 12 of which are new entries to the previous edition.)

5078 **NMR, EPR and Moessbauer effect: metals, alloys and compounds. Chapter 18.** Barnes, R.G. (Ames Lab., IA (USA)). pp 387-505 of Handbook on the physics and chemistry of rare earths. Vol. 2. Alloys and intermetallics. Gschneider, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). Amsterdam, Netherlands; North-Holland (1979).

The author discusses the experimental methods and results of the application of NMR, EPR and the Moessbauer effect in the study of rare earth metals, alloys and compounds.

5079 **(SAND—80-1264C) Deformation modeling and the strain transient dip test.** Jones, W.B.; Rohde, R.W.; Swearengen, J.C. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 34p. (CONF-801148—2). NTIS, PC A03/MF A01.

From ASTM conference on mechanical testing for deformation model development; Bal Harbour, FL, USA (12 Nov 1980).

Recent efforts in material deformation modeling reveal a trend toward unifying creep and plasticity with a single rate-dependent formulation. While such models can describe actual material deformation, most require a number of different experiments to generate model parameter information. Recently, however, a new model has been proposed in which most of the requisite constants may be found by examining creep transients brought about through abrupt changes in creep stress (strain transient dip test). The critical measurement in this test is the absence of a resolvable creep rate after a stress drop. As a consequence, the result is extraordinarily sensitive to strain resolution as well as machine mechanical response. This paper presents the design of a machine in which these spurious effects have been minimized and discusses the nature of the strain transient dip test using the example of aluminum. It is concluded that the strain transient dip test is not useful as the primary test for verifying any micromechanical model of deformation. Nevertheless, if a model can be developed which is verifiable by other experimentts, data from a dip test machine may be used to generate model parameters.

5080 **(SAND—80-2606C) Muon spin depolarization in metals with dilute magnetic impurities.** Brown, J.A.; Heffner, R.H.; Hutson, R.L. (Los Alamos National Lab., NM (USA); Los Alamos National Lab., NM (USA); Sandia National Labs., Albuquerque, NM (USA); Rice Univ., Houston, TX (USA); Iowa State Univ. of Science and Technology, Ames (USA)). 1980. Contract AC04-76DP00789. 8p. (CONF-801124—28). NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

Muon diffusion can be studied in metals without nuclear moments by the addition of paramagnetic impurities. The theory is de-

scribed and measurements are reported of muon depolarization in gold and silver doped with gadolinium and erbium. As well as diffusion rates, strength of the magnetic interaction and spin lattice relaxation rate of the paramagnetic ion are inferred from the data. 2 figures.

5081 **(SAND—80-2610C) Pulsed laser annealing of aluminum.** Wampler, W.R.; Follstaedt, D.M.; Peercy, P.S. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 8p. (CONF-801124—23). NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

Pulsed ruby laser irradiation of unimplanted single crystal and implanted polycrystalline Al has been studied with ion beam analysis and TEM. Results show that Al is melted to a depth of ~ 0.9 μm with a 4.2 J/cm², 15 ns pulse, and that vacancies are quenched into Al during resolidification. Diffusion of Zn in liquid Al is observed, and a melt time of ~ 65 ns is estimated for a 3.8 J/cm², 30 ns pulse. The observations are in reasonable agreement with calculations of sample temperature and melt times. We observe no precipitation of AlSb in liquid Al for Sb-implanted Al, and conclude that the nucleation time satisfies 50 ns ≦ t/sub nuc/ ≦ 200 ns. We find no evidence for amorphous Al after irradiation of single crystal Al with energies ≧ 1.5 J/cm².

5082 **(SU-DMS—80-R2) Modelling of deformation and fracture in high-temperature structural materials. Progress report, April 1, 1979-March 31, 1980.** Miller, A.K. (Stanford Univ., CA (USA). Dept. of Materials Science and Engineering). Apr 1980. Contract AT03-76ER70057. 52p. NTIS, PC A04/MF A01.

Objective is to develop analytical models for predicting both deformation and fracture in metals and alloys in energy-related systems. Progress reported includes high-temperature fatigue with hold time in ferritic materials; interactive solute strengthening in 316 ss; roles of forest dislocations and subgrains in isotropic hardening; back stresses at high strains and high temperatures; strain softening; and applications of MATMOD constitutive equations to 2 1/4 Cr-1 Mo alloy steel. (DLC)

5083 **(UWFDM—381) Further investigations of the upper critical field and the high field critical current density in Nb-Ti and its alloys.** Hawksworth, D.G.; Larbalestier, D.C. (Wisconsin Univ., Madison (USA)). Sep 1980. Contract AS02-78ET52048. 6p. (CONF-800980—32). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

This paper reports further measurements of Hc_2 in the Nb-Ti-Ta and Nb-Ti-Hf systems. Whilst we find only small enhancements of ~ 0.3 Tesla in $\mu_0 Hc_2$ (4.2°K) compared to binary Nb-Ti, at 2°K there is a wide composition range in the Nb-Ti-Ta system where $\mu_0 Hc_2$ (2°K) exceeds 15 Tesla, reaching a maximum of 15.5 Tesla. This represents an enhancement of 1.3 Tesla over unalloyed Nb-Ti. By comparison alloys in the Nb-Ti-Hf system show a maximum enhancement in $\mu_0 Hc_2$(2°K) of only 0.3 Tesla. The reasons both for the enhancements in Hc_2 and for the differences in behavior shown by alloys containing Ta and Hf are briefly discussed. This paper also discusses common features in the behavior of the high field critical current density, J/sub c/, of four commercial Nb-Ti composites and upon the basis of this behavior predict the enhancements in high field J/sub c/ to be expected from using Nb-Ti-Ta and its alloys.

5084 **Irradiation-enhanced mass flux and dislocation interactions.** Scattergood, R.O. (Argonne National Lab., IL (USA). Materials Science Div.). *NLJournal of Nuclear Materials (Journal des Materiaux Nucleaires) (Netherlands);* **90**: No. 1-3, 22-28(May 1980).

From International conference on fundamental mechanisms of radiation-induced creep and growth; Chalk River, Canada (8 - 10 May 1979).

The phenomenon of irradiation-enhanced mass flux depends on the interactions of vacancies and interstitials with sinks such as dislocations. At steady-state these interactions, along with the geometry of the body, determine the enhancement contribution. The situation may change somewhat with transient behavior because a difference in diffusivity can give rise to enhancement. Motivated by the importance of dislocation-sink interactions in various enhancement effects, a new method is given which permits the distortions and their derivatives to be numerically calculated for curvilinear dislocations in elastically anisotropic media. The method is based on a new, extended derivation of the geometric-theorem approach to dislocation field quantities. The distortion derivatives allow the interaction energy gradients required in the dislocation-sink diffusion boundary-value problem to be calculated, and it is hoped that the influence of dislocation geometry (curvilinear versus straight) and elastic anisotropy will be properly assessed using these results, and taken into account where required.

5085 **Bias factors for radiation creep, growth and swelling.** Nichols, F.A. (Argonne National Lab., IL (USA). Materials Science Div.). *NLJournal of Nuclear Materials (Journal des Materiaux Nucleaires) (Netherlands);* **90**: No. 1-3, 29-43(May 1980).

From International conference on fundamental mechanisms of radiation-induced creep and growth; Chalk River, Canada (8 - 10 May 1979).

Central to the present concepts of the origin of the radiation-induced creep, growth and swelling phenomena is the relative interaction of interstitials and vacancies with various sinks. Radiation-induced climb of dislocations, which figures in many theories of radiation creep and growth, requires the absorption of an excess of either vacancies or interstitials. On the other hand, radiation swelling requires the absorption of an excess of vacancies to effect void growth. These relative preferences are normally expressed in theoretical models by certain bias factors, or capture efficiencies, usually assumed to be constant. Several attempts have been made to estimate their magnitude theoretically but all are seen to involve errors or physically unrealistic assumptions. We present here a unified treatment in which these various bias factors are estimated in a self-consistent model which incorporates, for the first time, all the essential physics, i.e., defect production, interactions of both vacancies and interstitials with sinks and the presence of two types of sinks. We present quantitative evaluations for the SIPA creep model and for radiation swelling, and compare with previous estimates of these phenomena.

5086 **Irradiation creep by dislocation glide enabled by preferred absorption of point defects-theory and experiment.** Mansur, L.K.; Reiley, T.C. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.). *NLJournal of Nuclear Materials (Journal des Materiaux Nucleaires) (Netherlands);* **90**: No. 1-3, 60-67(May 1980).

From International conference on fundamental mechanisms of radiation-induced creep and growth; Chalk River, Canada (8 - 10 May 1979).

Creep by climb-enabled glide of dislocations may be calculated by mathematically specifying both the origin of the net point defect flux producing the climb and the mode of glide deformation. In general, the net flux contains components arising from (1) differences in point defect capture efficiencies among dislocations and other types of sinks such as cavities, and (2) from differences in capture efficiencies among dislocations whose Burgers vectors are at different orientations with respect to the stress direction. Proposed models based on the first component and employing several modes of glide deformation are reviewed. The characteristics of creep based on the second component, stress induced preferred absorption of point defects on dislocations and subsequent glide, PAG-creep, are described for one mode of glide deformation. Effects of point defect trapping at impurities on creep by this mechanism and on the corresponding climb component of creep are evaluated. Comparison is made with experimental data from light-ion irradiation. The sensitivity of predicted creep rates to the detailed microstructure is emphasized.

5087 **Development of the climb glide concept to describe in-reactor creep of fcc materials.** Chin, B.A.; Straalsund, J.L.; Gilbert, E.R. (Hanford Engineering Development Lab., Richland, WA (USA)). *NLJournal of Nuclear Materials (Journal des Materiaux Nucleaires) (Netherlands);* **90**: No. 1-3, 68-74(May 1980).

From International conference on fundamental mechanisms of radiation-induced creep and growth; Chalk River, Canada (8 - 10 May 1979).

The Climb Induced Glide model (CIG) for irradiation creep is developed using a plastic flow law which has been successfully applied in the correlation of type 316 stainless steel rupture data. This model is used to predict the stress and temperature dependence of irradiation creep and the transition from irradiation to thermal creep. The predictions of this model are compared and found to be qualitatively consistent with experimental data and microstructural information. This model allows prediction of deformation behavior covering strain rates from 1 x $10^{-13}s^{-1}$ to 1 s^{-1}.

5088 **Irradiation creep under 60 MeV alpha irradiation.** Reiley, T.C.; Shannon, R.H. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.); Auble, R.L. (Oak Ridge National Lab., TN (USA). Physics Div.). *NLJournal of Nuclear Materials (Journal des Materiaux Nucleaires) (Netherlands);* **90**: No. 1-3, 271-281(May 1980).

From International conference on fundamental mechanisms of radiation-induced creep and growth; Chalk River, Canada (8 - 10 May 1979).

Accelerator-produced charged-particle beams have advantages over neutron irradiation for studying radiation effects in materials, the primary advantage being the ability to control precisely the experimental conditions and improve the accuracy in measuring effects of the irradiation. An apparatus has recently been built at ORNL to exploit this advantage in studying irradiation creep. These experiments employ a beam of 60 MeV alpha particles from the Oak Ridge Isochronous Cyclotron (ORIC). The experimental approach and capabilities of the apparatus are described. The damage cross section, including events associated with inelastic scattering and nuclear reactions, is estimated. The amount of helium that is introduced during the experiments through inelastic processes and through backscattering is reported. Based on the damage rate, the damage processes and the helium-to-dpa ratio, the degree to which fast reactor and fusion reactor conditions may be simulated is discussed. Recent experimental results on the irradiation creep of type 316 stainless steel are presented, and are compared to light ion results obtained elsewhere. These results include the stress and temperature dependence of the formation rate under irradiation. The results are discussed in relation to various irradiation creep mechanisms and to damage microstructure as it evolves during these experiments.

5089 **Irradiation creep in transient irradiation environments.** Simonen, E.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). *NLJournal of Nuclear Materials (Journal des Materiaux Nucleaires) (Netherlands);* **90**: No. 1-3, 282-289(May 1980).

From International conference on fundamental mechanisms of radiation-induced creep and growth; Chalk River, Canada (8 - 10 May 1979).

Creep in a transient irradiation environment is examined theoretically. Pulsing the irradiation flux can enhance the predicted climb-glide creep rate. The enhancement is due to cyclic transients in the point defect fluxes which are shown to be a function of pulse duty cycle, pulse frequency and temperature. The pulsed mechanisms is only effective if the climb barrier height is of the order of a nanometer or less. Furthermore, the enhanced creep rate is expected to have a weak stress dependence. The SIPA creep rate, on the other hand, is reduced with pulsing because pulsing reduces the time-averaged interstitial flux as compared with a continuous irradiation having the same time-averaged damage rate. A final consideration in the present analysis is that of discontinuously stepping the irradiation temperature to induce a transient-enhanced climb-glide creep rate.

5090 **Creep in nickel bombarded with 17 MeV deuterons.** Henager, C.H.; Brimhall, J.L.; Simonen, E.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). *NLJournal of Nuclear Materials (Journal des Materiaux Nucleaires) (Netherlands);* **90**: No. 1-3, 290-296(May 1980).

From International conference on fundamental mechanisms of radiation-induced creep and growth; Chalk River, Canada (8 - 10 May 1979).

Irradiation creep data have been obtained with an apparatus designed to measure the irradiation creep of material subjected to light ion bombardment. The experiment apparatus has the capability to remotely set and control ion flux, stress and temperature for the creep test. Creep data have obtained from nickel, 152 μm thick, bombardement with 17 MeV D^+ ions at 473 K. It is shown that this choice of ion energy and specimen thickness results in minimal error induced by the stress gradient effect. Results to data indicate a nonlinear stress dependence of the creep rate with a stress exponent approx. 2.5. This result is in substantial agreement with that found by other investigators using light ion irradiations. Results also suggest that in the temperature and stress range being studied, a climb-glide creep mechanism is operative.

5091 **Weld pool chemistry and metallurgy. Volume I: papers.** Cambridge, England; Welding Institute (1980). 360p. £ 27.50.

Papers are presented concerning weld pool solidification; general welding behavior; porosity welding behavior; gas-metal-slag reactions; slag-metal reactions; and slag-metal reactions for submerged-arc welding.

5092 **Struktura i svoistva legkikh splavov. (Structure and properties of light alloys).** Korol'kov, A.M. (ed.). Contract AI01-77ET20344. New Delhi, India; Amerind Publishing Co. Pvt. Ltd. (1980). 221p. (TT—76-52003; ERDA-tr—75). NTIS, PC A10/MF A01.

In the present collection, articles are presented in which the results of physico-chemical investigations on noble and light alloys, carried out in recent times and connected with the development and adoption of the most promising alloys and their processing methods have been expounded. These investigations inlude, construction of binary and ternary phase diagrams, study of the effect of doping content of elements on the structure and properties of noble and light alloys, study of the process of crystallization, decay of supersaturated solid solution, recovery and recystallization. In these articles, great attention has been paid to the relation between various properies of alloys, e.g. mechanical, physical and others, and their structure as well as the conditions of producing one or other of these structures.

5093 **Statistical mechanical theory for activity coefficients of a dilute solute in a binary solvent.** Blander, M. (Argonne National Lab., IL); Saboungi, M.L.; Cerisier, P. *US-Metallurgical Transactions, B. Process Metallurgy (U.S.)Supersedes in part Metall. Trans.;* **10B**: 613-622(Dec 1979).

A statistical mechanical calculation of the activity coefficients of a dilute solute, C, in a binary solvent, A-B, was made using a model for the interactions of a coordination cluster consisting of a solute atom and its neighboring solvent atoms. The derived equations are applicable to a variety of types of ternary solutions including substitutional and interstitial alloys as well as additive and reciprocal molten salts. The theory takes into account the interactions between solute and solvent atoms (ions) as well as changes in interactions of the solvent atoms (ions) which are neighbors of solute atoms (ions). Prior theories such as those of Wagner and the quasi-chemical theories of Alcock and Richardson and Jacob and Alcock can all be shown to be special cases of the present theory. The dependence of the activity coefficients of a solute on the solvent composition is calcuated from a knowledge of the activity coefficients of the solvent compositionolvent components, solute activity coefficients in the two pure solvent components, a coordination number, a geometric factor which depends upon the type of solution, and a term which represents the nonadditivity of pair bond interactions within the cluster of a solute atom (ion) and its neighboring solvent atoms (ions). In the model, the thermodynamic properties of the solute are related to the relative concentrations of the different coordination clusters as well as to the thermodynamic properties of the solvent.

5094 **Crystal fields. Chapter 17.** Fulde, P. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (Germany, F.R.)). pp 295-386 of Handbook on the physics and chemistry of rare earths. Vol. 2. Alloys and intermetallics. Gschneider, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). Amsterdam, Netherlands; North-Holland (1979).

The various physical effects caused by the crystal field splitting of the RE-ions are discussed in some detail and possible directions of future research are indicated.

5095 **Crystal chemistry of intermetallic compounds. Chapter 13.** Iandelli, A.; Palenzona, A. (Genoa Univ. (Italy). Ist. di Chimica Fisica). pp 1-54 of Handbood on the physics and chemistry of rare earths. Vol. 2. Alloys and intermetallics. Gschneider, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). Amsterdam, Netherlands; North-Holland (1979).

This paper is concerned with compound formation in binary systems, compositions and structure types, metallic and ionic radii, mean atomic volumes and volume contractions, discussion of the most frequently occurring compositions (R_5X_3, RX, RX_2, RX_3) and intermetallic compounds with anomalous lanthanide valence states.

3602 Ceramics, Cermets, And Refractories

5096 (CONF-801079—, pp IV.8-IV.12) **Chemical and physical stability of refractories for use in coal gasification.** Day, D.E.; Lewis, G.L. (Univ. of Missouri, Rolla). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Over twenty commercial and generic compositions, representative of the classes of monolithic refractories considered for use in coal gasifiers, have been investigated. Properties such as density, porosity, flexural strength, and thermal expansion were determined before and after exposure to conditions simulating those at the cold face of a refractory lining. Changes in these properties were correlated with the chemical reactions occurring in the refractories during exposure as found by XRD and DTA/TGA. Based on the results of this study, the degree of saturation of the gas atmosphere is the single most important process parameter in coal gasification that can be anticipated to affect the properties of cement and phosphate-bonded refractories at temperature of $\leqq$ 500°C. If the temperature at some point in a cement or phosphate-bonded refractory lining in a coal gasifier approaches the dew point temperature of the atmosphere in the vessel, then the chemical reactions and accompanying changes in flexural strength described above should be anticipated.

5097 (CONF-801079—, pp IV.18-IV.24) **Investigation of CO disintegration of refractories in coal gasifiers.** Brown, J.J. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Based on the test data collected to date, the following observations have been made: CO disintegration of high alumina castables is not likely to be a problem in coal gasifiers at atmospheric pressure. This is evidenced by the data shown in Table I where all gases added to CO tended to retard refractory disintegration compared with samples exposured to pure CO. A 1000 hr exposure to a simulated coal gasifier atmosphere did not produce any visual damage or strength loss in either castable examined. CO disintegration of high alumina castables is a potential cause of refractory failure at high pressures. The time required for refractory deterioration rapidly decreases as pressure increases. The effect of even small amounts of iron impurities greatly accelerates the rate of disintegration. In coal gasifiers, CO disintegration is likely to affect the abrasion resistance of the refractories long before any of the typical signs of CO disintegration are noted. The 50% Al_2O_3 castable is more susceptible to abrasion than the 90% Al_2O_3 castable. The temperature range over which CO disintegration is active appears to be shifted to higher temperatures at high pressures. Preliminary results suggest that alkali compounds, particularly K_2CO_3, accelerate CO disintegration of high alumina castables. The 50% Al_2O_3 castable disintegrates faster than the 90% Al_2O_3 castable, possibly a result of the higher iron content of the calcined kaolin used in the 50% Al_2O_3 refractory. Stainless steel (AISI 316 and 446) reinforced castables possess very poor resistance to CO disintegration both at atmospheric and 1000 psi.

5098 (CONF-801079—, pp VI.21-VI.32) **High temperature applications of structural ceramics.** Schneider, S.J. (National Bureau of Standards, Washington, DC). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of this program is to characterize high temperature failure mechanisms and factors that influence their operation with an aim toward improving the properties of structural ceramics, especially silicon carbide and silicon nitride based materials, for use in coal conversion applications. The task is divided into four subtasks: 1. High Temperature Fracture: which will characterize the high temprature (up to 1600°C) deformation, crack growth, and fracture properties and develop theoretical models that describe the crack growth mechanisms for long-term reliability predictions. 2. Crack Growth Mechanism Maps: these maps will be developed as functions of temperature and stress intensity factor to describe regions of various crack growth mechanisms to aid in design and to predict ways of improving the fracture properties by altering the microstructure or chemistry of structural ceramics. 3. Thermochemistry: that will determine the relationship between mechanical properties and the thermodynamic, thermochemical and microstructure in an attempt to improve the properties by controlling low melting temperature compound formation, decomposition, and phase changes during fabrication and use of structural ceramics. 4. Kinetics of Oxidation: which will determine the factors that affect the oxidation resistance and oxidation products at elevated temperatures and evaluate the effects on fracture and crack growth due to internal microstresses caused by inclusions and anisotropy in order to improve the mechanical properties of structural ceramics.

5099 **(DOE/ER/04837—7) Electronic structure of defects in oxides. Final report, December 1, 1979-November 30, 1980.** Summers, G.P. (Oklahoma State Univ., Stillwater (USA)). 1980. Contract AS05-76ER04837. 21p. NTIS, PC A02/MF A01.

Details of the electronic structure of F-type centers in the series of oxides SrO, CaO, α-Al_2O_3 and $MgAl_2O_4$ have been determined using measurements of photoconductivity, luminescence, and fluorescence lifetimes. Measurements were made over the spectral range 2 to 6.5 eV and over the temperature range 4 to 350°K. The centers were introduced into SrO by electron, on proton or neutron bombardment, into CaO and α-Al_2O_3 by electron a neutron bombardment or thermochemical coloration, and into $MgAl_2O_4$ by particle bombardment. In some cases, notably CaO and α-Al_2O_3, the photoconductivity behaves differently depending on the method used to introduce the centers. In particular, neutron irradiated and some thermochemically colored samples of sapphire contain an effective electron trap with an optical transition energy of $\sim$ 5.0 eV and a thermal excitation energy of 0.72 eV as determined by measurements of photoconductivity, thermoluminescence and phosphorescence. This trap appears to be structural defect consisting of an aggragate of anion vacancies.

5100 **(DOE/ER/10591—1) Mechanisms of elevated temperature rupture in single phase ceramics. Progress report, March 1, 1980-January 31, 1981.** Solomon, A.A. (Purdue Univ., Lafayette, IN (USA)). Oct 1980. Contract AC02-80ER10591. 37p. NTIS, PC A03/MF A01.

Results and progress for the first year are reported. The constant true stress tensile creep system has been assembled and is largely operational. Fabrication of suitable tensile specimens has proceeded using slip-casting and punch and die forming. UO_2 swelling experiments have also been initiated. Problems of irregular presintering behavior of UO_2 in the pressure vessel are being investigated. Evidence suggests that tungsten oxides are acting as contaminants in UO_2. Initial swelling and gas release measurements using the quadrupole mass spectrometer system have been performed. Ni was selected for these preliminary experiments as representative of pure ductile materials with intragranular porosity and large grains. Large swelling strains of $\geqq$ 20% were observed prior to gas release, the magnitude varying inversely with the internal pressure. The maximum in the swelling rate coincides with the maximum in the gas release rate. The measured total gas released agrees fairly well with the amount of entrapped gass, assuming the pores close uniformly at 87% TD. Microstructural examination shows interlinked pores after release. Initial measurements of the

pressure and temperature dependencies of gas release have also been made.

5101 **(LBL—11568) Residual stresses and microcracking induced by thermal contraction inhomogeneity.** Evans, A.G.; Clarke, D.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Sep 1980. Contract W-7405-ENG-48. 32p. (CONF-800360—2). NTIS, PC A03/MF A01.

From International conference on thermal stresses in materials and structures in severe thermal environments; Blacksburg, VA, USA (19 Mar 1980).

Brittle materials are subject to microcrack formation at grain boundaries and at second phase particles. These cracks are induced by residual stress that results from incompatibilities in thermal contraction. The development of residual stress and its partial relaxation by diffusion (at elevated temperatures) are described. The evolution of microcracks within the residual stress fields is then examined. Particular attention is devoted to considerations of the critical microstructural dimension at the onset of microcracking.

5102 **(MLM—2780) Characterization of phase transitions in vanadium deuterium systems.** Tober, R.L. (Mound Facility, Miamisburg, OH (USA)). 18 Nov 1980. Contract AC04-76DP00053. 95p. NTIS, PC A05/MF A01.

Thesis.

Resistivity, calorimetry and x-ray diffraction techniques were used to investigate phase boundaries in the vanadium deuterium phase diagram for compositions with a deuterium to vanadium ratio between 0.649 and 0.80 and within the temperature range from 100 to 300°K. The nature of the $\gamma \rightarrow \delta$ transition that occurs at 144°K was also investigated. Phase boundaries determined in this research agreed qualitatively with those of other experimentors. The $\gamma \rightarrow \delta$ phase transition was found to be an order-disorder transition involving the reorientation of deuterium atoms and vacancies on lattice sites of the orthorhombic superstructures in the γ and δ phases.

5103 **(SAND—80-1283C) Microscopic study of metal hydrides using electron spin resonance.** Venturini, E.L. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 6p. (CONF-801124—24). NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

Electron spin resonance (ESR) of dilute paramagnetic ions in nonmagnetic metallic hydrides provides microscopic information about the hydrogen ions in the immediate vicinity of the impurity. By comparing ESR spectra for different host metals and several hydrogen/metal ratios, one can determine material properties including host lattice symmetry, phase boundaries and occupation of available sites by hydrogen. Examples are presented of ESR of dilute Er in group IIIB and IVB metal hydrides, demonstrating the sensitivity and versatility of ESR as a spectroscopic technique.

5104 **(SAND—80-8811) Gases in glass.** Shelby, J.E. (Sandia National Labs., Livermore, CA (USA)). Nov 1980. Contract AC04-76DP00789. 12p. NTIS, PC A02/MF A01.

The high mobility of helium and hydrogen in some glasses has been known for many years. The effect of diffusion-controlled reactions between glasses and a number of gases on the physical and optical properties of those glasses is also widely recognized. This paper presents a brief review of the experimental techniques used to study these problems, and of the current state of knowledge regarding the solubility, migration, and reaction of gases in glasses.

5105 **Magnetic properties of intermetallic compounds of rare earth metals. Chapter 14.** Kirchmayr, H.R.; Poldy, C.A.; Groessinger, R.; Haferl, R.; Hilscher, G.; Steiner, W.; Wiesinger, G. (Technische Univ., Vienna (Austria)). pp 55-230 of Handbook on the physics and chemistry of rare earths. Vol. 2. Alloys and intermetallics. Gschneider, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). Amsterdam, Netherlands; North-Holland (1979).

A comprehensive compilation of data on the magnetic properties of rare earth intermetallic compounds is presented and discussed.

5106 **Diffusion based phenomena in fast breeder fuel materials.** Matzke, H. (Commission of the European Communities, Karlsruhe, Germany). pp 202-213 of International conference on fast breeder reactor fuel performance. Norman, E.C.; Adamson, M.G.; Boltax, A.; Cox, C.M.; Little, W.W. Jr; Weber, E.T.; Lambert, J.D.B.; Roberts, J.T.A. (eds.). La Grange Park, IL; American Nuclear Society (1979).

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Self-diffusion of U and Pu was measured in MO_2, MC, MCN and MN(M = U + Pu). In both the fluorite structure of MO_2 and the rocksalt structure of MX (X = C + N + O), metal atom mobility is much slower than nonmetal atom mobilities, and can thus be rate-controlling for many high temperature properties. Effects of the most important parameters on diffusion was investigated: deviation from stoichiometry, impurity content including simulated burnup, and irradiation and fission itself. In oxides, diffusion controlled phenomena are a strong function of x (in MO/sub 2 +- x/): for $x \geq 0$, rates increase roughly proportional to x^2; at $x \sim -0.02$ (for 20% Pu), there is a minimum in diffusion rates with a change from vacancy to interstitial diffusion. For $x < -0.02$, (O/M < 1.98 for U/sub 0.8/Pu/sub 0.2/O/sub 2-x/), diffusion rates increase again until cluster formation occurs leading to saturation. The importance of this minimum in fuel fabrication (sintering, achieving of solid solutions to improve solubility for reprocessing) is discussed. Radiation enhanced diffusion is much more pronounced in oxides than in MX fuels thus explaining both the higher plasticity and creep rates in oxides. Related to this fact is also the phenomenon nf pronounced fission gas resolution in oxides. In contrast, MX-type fuels, radiation enhanced diffusion is much less pronounced. Thermally activated atomic mobilities decrease in the order MC > MCN > MN: this is true for non-metal and metal diffusion, fission gas release, sintering and grain growth explaining many of the differences in behavior under irradiation between carbides and nitrides. Diffusion controlled proceses in MX-type fuels are strongly dependent on impurities (e.g. fission products) and the composition dependence for MC is opposite to that of MN, indicating different bonding conditions in the two MX-type fuels. 8 figures.

3603 Composite Materials

5107 **(SAND—80-1060C) Thermomechanical characterization of graphite/polymide composites.** Kunz, S.C. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 38p. (CONF-801148—3). NTIS, PC A03/MF A01.

From ASTM conference on mechanical testing for deformation model development; Bal Harbour, FL, USA (12 Nov 1980).

The stiffness, strength and shear properties of three polyimide resins (NR-150B2, PMR-15 and CPI-2237) combined with three different moduli graphite fibers (C-6000, F-5A and GY-70) were determined at 20 to 371°. Stiffness retention with increasing temperature is affected only by the thermal integrity of the polymide matrix. No loss in modulus occurs up to 316°C for the PMR-15 and CPI-2237 based composites (T/sub g/ = 377°C) or to 260°C for the NR-150B2 based material (T/sub g/ ≈ 349°C), with any of the three fibers. Both flexure and shear strengths show fiber dependent behavior with temperature. The higher modulus fiber composites (F-5A, GY-70) undergo little strength change up to 343°C. Composite strengths of the lower modulus fibers (C-6000), however, degrade by as much as 50% over the same temperature range. Thermal-oxidative stability of the various graphite fibers, and its effect on interfacial strength degradation, are considered primary causes for the fiber-type dominated strength behavior. In general, strength retention appears directly related to degree of graphitization (modulus) of the fibers. The accumulated mechanical property data, some previously unknown, are correlated with microstructural features such as the fiber-matrix adhesion, porosity and processing defects. 11 figures.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 4697, 4697, 5029

5108 **(DOE/ER/01198—1327) High pressure luminescence probes in polymers.** Drickamer, H.G. (Illinois Univ., Urbana (USA). Materials Research Lab.). 1980. Contract AC02-76ER01198. 24p. (CONF-801216—1). NTIS, PC A02/MF A01.

From Conference on structure and properties of molecular glasses; New York, NY, USA (8 Dec 1980).

High pressure luminescence has proved to be a very powerful tool for characterizing crystalline solids and liquids. Two problems involving glassy polymers are analyzed. In the first problem the excited states of azulene and its derivatives are used to probe intermolecular interactions in PMMA and PS. In the second problem the change in emission intensity with pressure from two excimer states of polyvinylcarbazole as a pure polymer and in dilute solution in polystyrene (PS), polymethylmethacrylate (PMMA) and polyisoliutylene (PIB) is studied. The relative emission from the two states depends strongly on the possibility for motion of polymer segments. The observations are related to the proximity to the glass transition.

5109 **(MHSMP—80-63) Selected physical and thermal properties of various formulations of silicone potting compounds.** Flowers, G.L.; Faubion, B.D.; Montague, J.L.; Switzer, S.T. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Nov 1980. Contract AC04-76DP00487. 18p. NTIS, PC A02/MF A01.

Some of the physical and thermal properties are presented of materials developed as substitutes for additional cured silicone potting compounds which are no longer produced by Dow Corning. The six raw materials tested were: Sylgard 186; Sylgard 184; Q3-6527 Dielectric Gel; Q3-6559 Accelerator; DC-1107; and Cabosil MS-75. Test data are reported for: disk or punch shear strength; lap shear strength; butt tensile strength; compressive strength; bulk tensile strength; durometer hardness; dynamic shear modulus; density; crosslink density; coefficient of thermal expansion; thermal conductivity; specific heat; and thermal diffusivity. All samples were prepared and cured at 25°C. Unless otherwise stated, all samples were tested at 25°C after a minimum cure time of 30 days. (LCL)

5110 **(UCRL—52434(Vol.7)) Development of alternate silicone potting compounds. Volume 7. Development of secondary alternates for Dow Corning's Aerospace Sealant, DC93-120.** Cady, W.E.; Buckner, A.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Aug 1980. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01.

A substitute for Dow Corning DC93-120 silicone potting compound can be formulated from Sylgards 184 and 186 resins and either accelerator QCF3-6559 or DC1107 fluid. Substitutes can also be formulated from Sylgard 186, dielectric gel Q3-6527, and DC1107 or from Sylgard 184, silicone dioxide, and accelerator QCF3-6559.

3606 Other Materials

5111 **(PNL-SA—8975) Natural analogues for crystalline radioactive waste forms. Part II. Non-actinide phases.** Haaker, R.F.; Ewing, R.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1980. Contract AC06-76RL01830. 9p. (CONF-801124—26). NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

The purpose of this paper is to summarize relevant geologic literature on mineral analogues to important non-actinide phases in synroc and supercalcine. Solid solution chemistry, occurrence, and alteration effects are emphasized. Stable and unstable mineral associations are identified. The report also summarizes the behavior of mineral analogues to the actinide phases in synroc and supercalcine.

5112 **(SAND—80-1850) Ultrasonic shear wave velocity in CLF/CMT graphite from room temperature to 2000°F.** Gieske, J.H. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01.

The temperature dependence of the ultrasonic shear velocity in CLF/CMT graphite was determined from room temperature to 2000°F using a pulse-echo technique. Data are presented for five 0.75-inch-diameter specimens all machined from the same CLF/CMT billet. Plots of ultrasonic pulse-echo radial and axial scans of the billet which characterize the material property uniformity of the billet are also given.

5113 **Low pressure pneumatic lifter.** Ingle, W.M.; Rosler, R.S.; Thompson, S.W.; Bennett, D. (to Dept. of Energy). US Patent Application 123,605. 22 Feb 1980. 15p.

A low pressure pneumatic lifter apparatus is provided in which gas-solid heterogeneous reactions take place under low pressure conditions (e.g., less than one atmosphere). The apparatus includes an elongate lifter or riser tube to which solid particles are supplied for entrainment by a carrier gas for reaction with reactant gas. The solid particles and reactant gas are supplied at the base of the lifter tube and react as they pass upwardly through the tube. A vacuum pump provides upward movement of the particles while maintaining the low pressure in the lifter tube. In a preferred embodiment, the apparatus is used for silicon harvesting, with heated silicon particles reacting with Si/sub x/F/sub y/ homologues supplied together with SiF_4 fluidizing gas from a vaporizer for (SiF_2)/sub x/ polymers.

40 CHEMISTRY

REFER ALSO TO CITATION(S) 5565

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 4477, 4477, 4547, 4547, 4548, 4548, 4549, 4549, 4550, 4550, 4551, 4551, 4552, 4552, 4576, 4601, 4602, 5247, 5316, 5402, 5526, 5528

5114 **(DPSPU—80-30-7) Improved Emission Spectrographic Facility.** Goergen, C.R.; Lethco, A.J.; Hosken, G.B.; Geckeler, D.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Oct 1980. Contract AC09-76SR00001. 11p. (CONF-801107—45). NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The Savannah River Plant's original Emission Spectrographic Laboratory for radioactive samples had been in operation for 25 years. Due to the deteriorated condition and the fire hazard posed by the wooden glove box trains, a project to update the facility was funded. The new laboratory improved efficiency of operation and incorporated numerous safety and contamination control features.

5115 **(ORNL/MIT—314) Recovery of silver from waste liquids of photoreproduction equipment.** Rauenzahn, R.M.; Lee, Y.B. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Nov 1980. Contract W-7405-ENG-26. 28p. NTIS, PC A03/MF A01.

Several processes for removing silver and cyanide from waste photographic solutions were investigated through a review of current literature. Anion exchange was chosen as most promising and was evaluated with respect to four of the major liquids produced at ORNL. Anion exchange was deemed unnecessary or impractical as a primary treatment for two of the largest-volume solutions, due to the presence of colloidal silver or low concentrations of dissolved silver. However, further study is warranted, particularly in the use of Amberlite anion exchange resins to purify the 3M activator rinse and Kodak fixer solutions.

5116 (ORNL/TM—6706) Mathematical model for multicomponent separations on the continuous annular chromatograph. Bratzler, R.L.; Begovich, J.M. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 83p. NTIS, PC A05/MF A01.

A model for multicomponent separations on ion exchange columns has been adapted for use in studying the performance of the continuous annular chromatograph. The model accurately predicts solute peak positions in the column effluent and qualitatively predicts trends in solute effluent resolution as a function of increasing bandwidth of the solute feed pulse. The major virtues of the model are its simplicity in terms of the calculations involved and the fact that it incorporates the nonlinear solute-resin binding isotherms common in many ion exchange separations. Because dispersion effects are not accounted for in the model, discrepancies exist between the shapes of the effluent peaks predicted by the model and those determined experimentally.

5117 (PB—80-810005) Chemical analysis of steel (citations from the NTIS Data Base). Report for 1964-Apr 80. Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1980. 247p. NTIS PC N01/MF N01.

Information is cited on chemical analysis of boron, nitrogen, hydrogen, sulfur, silicon, carbon, oxygen, aluminum, rare earths, and other trace elements in steel. In addition, research on the determination of major elements, including iron, is covered. New techniques and refinement of older techniques, including x-ray fluorescence, spectroscopy, chromatography, activation analysis, and wet chemical methods are also included. (This updated bibliography contains 240 abstracts, 14 of which are new entries to the previous edition.)

5118 (STU—78-6706) Catalyst based instrument for measuring nitric oxides. Larsson, R.; Larsson, L.; Rebenstorf, B. (Styrelsen foer Teknisk Utveckling, Stockholm (Sweden)). May 1980. 40p. (In Swedish). (STU—76-5030; STU—77-6407). NTIS, PC A03/MF A01.

The potential of using catalytic reactions for measuring chemical substances in the atmosphere has been investigated. The first part of the project concerned nitrogen oxides and the second part aromatic isocyanates. The measuring method implies conversion of the substance in question by means of a catalyst into such a sort which is easier to measure. The analysis of NO/sub x/ is performed by catalytic oxidation of NO to NO_2, which is then measured with a photometer. Higher concentrations of NO can be measured by means of coloring of the adsorption column. In this case NO_2 is catalytically disproportioned into NO and HNO_3. The method was applied to the reaction $C_6H_5NCO + 8.75\ O_2 = 7\ CO_2 + 2.5\ H_2O + NO_2$. The system CO^{2+}/SiO_2, which is a coordinatively unsaturated surface compound, also was a good catalyst for this reaction. Other aromatic nitrogen compounds were oxidized in the same temperature interval which made the application impossible. The general principle, however, seems to be convincing.

5119 (UCRL-Trans—11638) Use of carbon materials in the design of indicator electrodes for volumetric determinations of organic compounds. Remes, M.; Vytras, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1980. Translation source information not available . 7p. NTIS, PC A02/MF A01.

Ways carbon or graphite are used in designing indicator electrodes for volumetric analysis of organic compounds are discussed. Some of the uses of carbon and graphite electrodes are: anodic voltammetry as in the determination of guanine in the presence of adenine, cystosine and other natural purines and pyrimidines; amperometric titration of potassium ions with a volumetric solution of tetraphenyl borate, which oxidizes on the graphite electrode; amperometric titration without an external applied voltage for determination of organic amines by titration with sodium nitrate in a medium of dilute hydrochloric acid; potentiometric titrations of bases and reducing compounds in a medium of acetic acid; qualitative organic analysis for identification of the structure of organic compounds, in the study of chemical, physicochemical and biological properties; and electrochemical syntheses in the sense of preparative syntheses of organic compounds, particularly in the generation of free radicals for studying electron spin resonance. The rapid development of ion-selective electrodes also fosters new opportunities for the use of carbon materials in the design of indicator elements in volumetric analysis of organic compounds. Carbon materials can be used to design electrodes equipped with both solid-state and liquid-state membranes, or else in the design of electrodes of the coated-wire type.

5120 Recovery of naphthalene during evaporative concentration. Higgins, C.E.; Guerin, M.R. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *USAnalytical Chemistry (U.S.);* **52**: No. 12, 1984-1987(Oct 1980).

The analysis of trace organics usually requires concentrating organic extracts to small volumes prior to instrumental analysis. The use of a concentration apparatus employing a nitrogen blanket and reduced pressure is desirable because the inert atmosphere and low temperature help to ensure stable composition. Unfortunately, diaromatic compounds such as the naphthalenes and biphenyls are frequently almost completely lost during the concentration step. Even under carefully controlled conditions only 26 +- 11% of the naphthalene is recovered. By placing a sorbent either in or downstream of the evaporation concentration flask, recovery of diaromatic compounds can be improved significantly. In this investigation, the following sorbents, Tenax, XAD-2, POR-Q, and XE-340 were tested. Recoveries with and without the use of sorbents, effects of solute concentration, purge time after solvent removal, and type of solvent used are reported here.

5121 Mass-spectrometric stable-isotope-dilution analysis for lanthanides in geochemical materials. Chapter 37G. Schuhmann, S.; Philpotts, J.A. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). pp 471-481 of Handbook on the physics and chemistry of rare earths. Vol. 4. Non-metallic compounds - II. Gschneider, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). Amsterdam, Netherlands; North-Holland (1979).

Stable isotope dilution mass-spectrometry (MSID) is the most accurate technique for determining lanthanide abundances in geochemical materials. The authors summarize the fundamental theory and scope of the MSID method, describe in some detail the chemical preparation and the mass spectrometry of the samples, and conclude with a brief discussion of data calculation and quality.

5122 Optical diagnostics in CVD reactors. Miller, G.H.; Mulac, A.J.; Hargis, P.J. Jr. (Sandia Labs., Albuquerque, NM). *USNational Bureau of Standards (U.S.), Special Publication (U.S.);* **2**: No. 561, 1135-1152(1979). (NBS-SP—561(Vol.2); CONF-780941—(Vol.2)).

From 10. materials research symposium; Gaithersburg, MD, USA (18 Sep 1978).

The application of spontaneous rotational Raman and fluorescence spectroscopy to linear CVD reactors is discussed. N_2 rotational temperature profiles were obtained above a susceptor at 600, 800, and 950°C. The gas flow conditions and susceptor temperatures investigated cover the transition regime between dominance of the flow by inertial or by buoyancy effects. Fundamental data needed to carry out fluorescence measurements of CVD gases and intermediates are being obtained. NH free radicals for these studies were produced by the 266 nm photodissociation of NH_3.

5123 Surface charge density determination of micaceous minerals by ^{235}U fission particle track method. Lee, S.Y.; Jackson, M.L. (Univ. of Wisconsin, Madison). *USClays and Clay Minerals (U.S.);* **25**: 295-301(1977).

The surface charge density of mica cleavages was determined by counting the number of fission particle tracks in a given area of a 6-mm muscovite disc replica with optical and scanning electron microscopy after saturation of the layer charge by washing with 0.5 M $UO_2(NO_3)_2$ solution, dilution of the excess salt by washing with 0.01 M $UO_2(NO_3)_2$ in 0.005 M HNO_3 (pH 2.4), blotting off the excess liquid, thermal neutron activation in contact with the muscovite disc, etching the muscovite, and counting the ^{235}U fission tracks/cm^2. Strong adsorption of uranyl cations (in a form not replaced by washings with a neutral salt solution), which occurred in the defects of micaceous minerals, is important in the interpreta-

tion of actinide element retention in soils and sediments wherein these minerals are abundant.

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5124 (ARI-RR—235) Homogeneous chemistry of NO/ sub x/ production and removal from fossil fuel combustion gases. Final technical report. Silver, J.A.; Gozewski, C.M.; Kolb, C.E. (Aerodyne Research, Inc., Bedford, MA (USA). Center for Chemical and Environmental Physics). Nov 1980. Contract AC21-78ET15161. 112p. NTIS, PC A06/MF A01.

The reduction of NO/sub x/ emissions from stationary combustion sources by non-catalytic homogeneous chemical addition is a promising technique. Demonstrations in laboratory experiments and on a number of field scale combustors have shown that the addition of ammonia to the exhaust flow significantly reduces the NO concentrations in a narrow temperature range. This report summarizes the work performed to understand the detailed chemical mechanism which makes this reduction occur. A model describing the NH/sub i//NO/sub x/ chemical system is developed, and rates of the key reactions identified are measured in a high temperature fast flow reactor. Product channels for certain important reactions are also identified. The experimental results are incorporated into the computer code, and the model predictions are compared with laboratory and field test results. Possible additives other than ammonia are evaluated and discussed.

5125 (BNL—28479) Mechanistic aspects of the homogeneous water gas shift reaction. Slegeir, W.A.R.; Sapienza, R.S.; Easterling, B. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 25p. NTIS, PC A02/MF A01.

Two reaction pathways for the homogeneous water gas shift reaction were found to be operative. An associative-type mechanism involving nucleophilic attack on a carbonyl ligand is indicated for ruthenium carbonyl complexes promoted by trimethylamine. This highly active system is favored by the dissociation of ruthenium clusters into mononuclear species. In contrast, Group VI metal carbonyl complexes demonstrate a dissociative mechanism, in which loss of a carbonyl ligand and formation of a formato complex are essential steps. An experiment, employing the technique of indirect photochemistry, is described to support this mechanism. These results provide a greater understanding of carbon oxide interactions in catalyst systems and of homogeneous analogues for heterogeneous reactions.

5126 (DOE/ER/04987—1) Solid state, surface and catalytic properties of oxides. Progress report, October 1, 1979-October 31, 1980. Kung, H.H. (Northwestern Univ., Evanston, IL (USA). Dept. of Chemical Engineering). Oct 1980. Contract AS02-78ER04987. 8p. NTIS, PC A02/MF A01.

Fundamental studies on oxide catalysts have been conducted with emphasis on the investigation of the properties of anion and cation vacancies on an oxide surface, on the characterization of an adsorbed oxygen species on an oxide, and on the determination of surface cation densities in solid oxide solutions. An automically well ordered surface of ZnO has been successfully prepared on which a high density of sites resembling those of the anion vacancy is present. Such a surface adsorbs oxygen and methanol more strongly, yet carbon dioxide more weakly than a stoichiometric nonpolar surface. From the kinetics of adsorption and desorption, evidence of an atomic adsorption of oxygen on iron oxide has been observed. The adsorption of this species is activated, and its desorption follows a bimolecular rate law. Attempts are being made to obtain the activation energies of adsorption and desorption, and the saturation coverage of the species. Its reaction with hydrocarbons will be studied later. The surface cation densities of Fe and Cr on a series of solid solutions of Fe_2O_3-Cr_2O_3 were determined. It was found that Fe was enriched on the surface at low Fe contents, but depleted from the surface at high Fe contents. The surface Cr on air treated samples is Cr(VI). Calculation on the surface cation densities of oxide solid solutions of cubic structure was performed using a pairwise potential, and a statistical model for the surface layer. For dilute bulk solutions, the larger cation is found to be enriched on the surface.

5127 Europium chalcogenides: EuO, EuS, EuSe and EuTe. Chapter 19. Wachter, P. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkoerperphysik). pp 507-574 of Handbook on the physics and chemistry of rare earths. Vol. 2. Alloys and intermetallics. Gschneider, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). Amsterdam, Netherlands; North-Holland (1979).

A comprehensive review of the properties of the europium chalcogenides is presented. 160 references.

5128 (LA-UR—80-3377) Boron trichloride purification with a KrF excimer laser. Hyer, R.C.; Hartford, A. Jr.; Atencio, J.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 12p. (CONF-801201—2). NTIS, PC A02/MF A01.

From 3. international conference on lasers and applications; New Orleans, LA, USA (15 Dec 1980).

Selective ultraviolet photolysis using a KrF excimer laser has been used to substantially reduce the phosgene impurity in a binary mixture of boron trichloride and phosgene. Infrared spectroscopic analysis of the sample before and after irradiation shows that it is possible to highly purify commercially available boron trichloride with this technique.

5129 Enthalpies of solution and formation of Cs_2CO_3. Johnson, G.K.; Gayer, K.H. (Argonne National Lab., IL (USA)). *GBJournal of Chemical Thermodynamics, The (England - U.S.);* **12**: No. 7, 705-708(Jul 1980).

The standard enthalpy of solution of Cs_2CO_3 in water is -(56.38 +- 0.52)kJ mol^{-1} based on measurements of the enthalpy of solution in CsOH(aq). The standard enthalpy of formation of Cs_2CO_3, $\Delta H°$/sub f/(Cs_2CO_3, c, 298.15 K), is -(1134.93 +- 0.63)kJ mol^{-1}.

5130 (LBL—11339) Catalytic synthesis of hydrocarbons over Group VIII metals: a discussion of the reaction mechanism. Bell, A.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Chemical Engineering). Sep 1980. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01.

The renewed interest in Fischer-Tropsch synthesis experienced during the past decade has motivated a careful reexamination of the previously proposed mechanisms and brought forward a number of new results. The most significant outcome of these recent investigations has been the suggestion that nonoxygenated, rather than oxygenated, intermediates play a dominant role in the synthesis of hydrocarbons from CO and H_2. Moreover, results obtained from the fields of surface science organometallic chemistry, and catalysis strongly support the hypothesis that hydrocarbon synthesis is initiated by the dissociation of CO and that the carbon atoms thus produced are hydrogenated to form adsorbed methylene and methyl groups. The latter species may be considered as precursors to methane as well as centers for hydrocarbon chain growth, a process which is postulated to begin by the insertion of a methylene group into the metal-carbon bond of a methyl group. The function of this review is to summarize the evidence leading to this view of Fischer-Tropsch synthesis and to illustrate its implications for the synthesis of hydrocarbons. In addition, brief discussions are presented concerning the participation of olefins in secondary reactions, which serve to alter the final distribution of products, and the relationship of the mechanism of hydrocarbon synthesis to that for the synthesis of oxygenated products.

5131 (LBL—11678) Chemical and catalytic properties of elemental carbon. Chang, S.G.; Brodzinsky, R.; Gundel, L.A.; Novakov, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 39p. (CONF-8010135—1). NTIS, PC A03/MF A01.

From General Motors Research Laboratory conference, particulate carbon: atmospheric life cycle; Warren, MI, USA (12 Oct 1980).

Elemental carbon particles resulting from incomplete combustion of fossil fuel are one of the major constituents of airborne particulate matter. These particles are a chemically and catalytically active material and can be an effective carrier for other toxic air

pollutants through their adsorptive capability. The chemical, adsorptive, and catalytic behaviors of carbon particles depend very much on their crystalline structure, surface composition, and electronic properties. This paper discusses these properties and examines their relevance to atmospheric chemistry.

5132 **(LBL—11697) Study of fundamental reaction pathways for transition metal alkyl complexes. I. The reaction of a nickel methyl complex with alkynes. II. The mechanism of aldehyde formation in the reaction of a molybdenum hydride with molybdenum alkyls.** Huggins, J.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 206p. NTIS, PC A10/MF A01.

Thesis.

This study reports the rapid reaction under mild conditions of internal or terminal alkynes with methyl(acetylacetonato) (triphenylphosphine) nickel (1) in either aromatic or ether solvents. In all cases vinylnickel products are formed by insertion of the alkyne into the nickel-methyl bond. In order to investigate the stereochemistry of the initial insertion, a x-ray diffraction study of the reaction of (1) with diphenylacetylene was carried out. This showed that the vinylnickel complex formed by overall trans insertion was the product of the reaction. The reaction of $CpMo(CO)_3H$ with $CpMo(CO)_3R$ (2, R = CH_3, C_2H_5) at 50°C in THF gives the aldehyde RCHO and the dimers $[CpMo(CO)_3]_2$ (3a) and $[CpMo(CO)_2]_2$ (4a). Labeling one of the reactants with a methylcyclopentadienyl ligand it was possible to show that the mixed dimers $MeCpMo(CO)_3$-$(CO)_3MoCp$ (3b) and $MeCPMO(CO)_2$ = $(CO)_2MoCp$ (4b) are the predominant kinetic products of the reaction. A mechanism is proposed.

5133 **Photoelectron study of the interaction of CO with ZnO.** Gay, R.R. (Massachusetts Inst. of Tech., Lexington); Nodine, M.H.; Henrich, V.E.; Zeiger, H.J.; Solomon, E.I. *USJournal of The American Chemical Society (U.S.);* **102**: No. 22, 6752-6761(22 Oct 1980).

Ultraviolet photoelectron spectroscopy (UPS) has been used to study the chemisorption of CO on four low-index surfaces of ZnO, an active methanol catalyst. These surfaces have significant differences with respect to their coordination unsaturation; thus, a correlation between the adsorption behavior and the surface structure enables the geometric requirements for chemisorption to be determined. The He II photoelectron peak associated with the 4 σ molecular orbital of the CO molecule serves as a probe of the amount of adsorbed CO. The adsorption is found to be reversible, and measurements of the equilibrium coverage as a function of temperature and pressure demonstrate that the bonding interactions are very similar on all four surfaces, with an initial heat of adsorption of 12.0 +- 0.4 kcal/mol, which decreases approximately linearly with coverage. Chemisorbed CO is readily displaced by NH_3, indicating the involvement of zinc ions in the bonding of CO to the surface. This is strongly supported by the relative CO coverage of the four surfaces under equivalent conditions, which generally correlates with the availability of unsaturated zinc sites. Angle-resolved measurements of the 4 σ intensity are used to confirm this binding mode. The bonding of CO to ZnO is cominated by the σ donor interaction of the carbon end of the molecule with the zinc ion as determined from the observed decrease in the splitting of the energies of the 4 σ and 5 σ molecular orbitals. The lack of significant π back-bonding is supported by the increase of the dipole moment of the coordinated CO molecule to approximately 0.6 D as determined from He I photoelectron work function measurements. This mode of binding of CO is consistent with the observed increase in the CO stretching frequency relative to the gas-phase value and suggests possible relevance to catalysis.

5134 **Mutual diffusion coefficients, electrical conductances, osmotic coefficients, and ionic transport coefficients l/sub ij/ for aqueous $CuSO_4$ at 25°C.** Miller, D.G. (Univ. of California, Livermore); Rard, J.A.; Eppstein, L.B.; Robinson, R.A. *USJournal of Solution Chemistry (U.S.);* **9**: No. 7, 467-496(Jul 1980).

Experimental thermodynamic and transport data are presented for aqueous $CuSO_4$ solutions at 25°C from low concentrations to near saturation. Included are diffusion coefficients (Rayleigh interferometry), electrical conductances (DC method), and osmotic coefficients (isopiestic). These data and corresponding literature data are critically compared, as are literature density data. The resulting best values, together with previously compared transference number results, provide an extensive set of critically reviewed data for aqueous $CuSO_4$. Onsager coefficients l/sub ij/ have been calculated for this salt and are compared with data for other valence types.

5135 **Preparation and properties of $AgUF_6$ and $AgUOF_5$.** Malm, J.G. (Argonne National Lab., IL (USA)). *GBJournal of Inorganic and Nuclear Chemistry (England);* **42**: No. 7, 93-994(1980).

$AgUF_6$ and $AgUOF_5$ are formed by precipitation from liquid hydrogen fluoride. Chemical and physical properties are described.

5136 **Preparation and lattice parameters of ^{249}Bk monopnictides.** Damien, D.; Haire, R.G.; Peterson, J.R. (Oak Ridge National Lab., TN (USA)). *GBJournal of Inorganic and Nuclear Chemistry (England);* **42**: No. 7, 995-998(1980).

The berkelium monopnictides have been prepared as single-phase materials by heating elemental ^{249}Bk with the corresponding pnictogen element in evacuated quartz tubes. The monopnictides exhibit the NaCl-type, cubic structure with observed lattice parameters (A) of 4.951 for BkN, 5.669 for BkP, 5.829 for BkAs, and 6.191 for BkSb.

5137 **(ORNL-tr—4702) Study of the ionization of C, N, O, Ne, Ar, Kr and Xe positive ions by electron impact.** Donets, E.D.; Ovsyannikov, V.P. (Oak Ridge National Lab., TN (USA)). 1980. Translation of a Russian preprint. 15p. NTIS, PC A02/MF A01.

A description of the methods used for measuring and the results for all positive ions of C, N, O, Ne, and Ar, excluding Ne^{1+} and $Ar^{1+\ 2+}$, as well as qualitative data for Kr and Xe, are presented. A comparison is presented with theoretical values in those cases where they are available.

5138 **Valence changes in compounds. Chapter 20.** Jayaraman, A. (Bell Labs., Murray Hill, NJ (USA)). pp 575-611 of Handbook on the physics and chemistry of rare earths. Vol. 2. Alloys and intermetallics. Gschneider, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). Amsterdam, Netherlands; North-Holland (1979).

The author discusses phase transitions involving valence changes in rare earth monochalcogenides. Effects on electronic and magnetic properties and on crystal structure are examined.

5139 **Evaluation and compilation of the thermodynamic properties of high temperature species.** Chase, M.W.; Downey, J.R.; Syverud, A.N. (Dow Chemical Co., Midland, MI). *USNational Bureau of Standards (U.S.), Special Publication (U.S.);* **2**: No. 561, 1581-1596(1979). (NBS-SP—561(Vol.2); CONF-780941—(Vol.2)).

From 10. materials research symposium; Gaithersburg, MD, USA (18 Sep 1978).

A continuous effort is being made to add new chemical species to the JANAF Thermochemical Tables and to revise existing outdated tables. The selection of species to be studied depends on current interest of the US Air Force and US Department of Energy. In addition to producing these tables, we are concerned with making improvements in three areas. First, prompted by user's comments, we hope to include additional information such as heats of atomization, crystal structures and more detailed transition data. Second, calculational techniques are being re-evaluated, upgraded, or extended, where necessary, and fully documented. For example, the monatomic gas partition function has been re-examined to provide a better assessment of uncertainty and a possible extension of the tables to temperatures in excess of 6000 K. Accuracy of various forms of the diatomic gas partition function is under study. Where it is practical and appropriate, we now include higher-order corrections and, in some cases, rotation-vibration cutoff. Third, duplicate efforts are being reduced by cooperative ventures with other data centers and researchers. All efforts to provide high quality thermochemical tables are limited by the available experimental and theo-

retical data. The interaction between the tables and the data will be discussed in terms of the limitations each imposes on the other.

5140 **Bridged ferrocenes. IV. The crystal and molecular structure of 1,1',2,2',3,3',4,5,4','-pentakis(trimethylene)ferrocene.** Spaulding, L.D. (Brookhaven National Lab, Upton, NY); Hillman, M.; Williams, G.J.B. Contract EY76-C-02-0016. *NLJournal of Organometallic Chemistry (Amsterdam) (Netherlands);* **155**: 109-116(1978).

The title compound (molecular formula $C_{25}H_{30}Fe$) forms prismatic crystals from hexane which belong to the monoclinic space group $P2_1/n$ with lattice constants a 9.486(2), b 12.134(2), c 16.024(2) A, β 93.12(1)°, and Z = 4. The structure was solved by the heavy atom method and refined by full-matrix least squares against 3839 F^2 terms to yield R = 0.08 and R/sub w/ = 0.12. The Fe to cyclopentadienyl ring-carbon distances range from 1.985(3) to 2.042(4) A. The two ciclopentadienyl rings are eclipsed, they are slightly non-planar, and the angle between their least-squares planes is 12.5°. 1 figure, 7 tables.

5141 **Bridged ferrocenes. III. The crystal and molecular structure of 1,1',2,2',3,4,4',5'-etrakis(trimethylene)ferrocene.** Hillman, M.; Fujita, E. (Brookhaven National Lab., Upton, NY). Contract EY76-C-02-0016. *NLJournal of Organometallic Chemistry (Amsterdam) (Netherlands);* **155**: 99-108(1978).

The structure of 1,1',2,2',3,4,4',5'-etrakis(trimethylene)ferrocene has been determined by x-ray diffraction. This compound forms prismatic crystals of monoclinic space group $P2_1/c$ and four molecules in the unit cell with a 8.649(4), b 21.623(2), c 9.120(1) A and β 107.21(3)°. The structure was solved from three dimensional Patterson and Fourier synthesis, and was refined by least squares. The two cyclopentadienyl rings are eclipsed and the dihedral angle between the rings is 11.1°. The iron-carbon distances ranged from 1.997(2) to 2.047(2) A. 2 figures, 5 tables.

5142 **Density of solid krypton at melting and isochoric equation of state of solid krypton and solid argon.** Macrander, A.T. (Cornell Univ., Ithaca, NY). Contract EY-76-C-02-1198. *DDPhysica Status Solidi (a). Applied Research (East Germany)Supersedes in part Physica Status Solidi;* **48**: 571-579(1978).

Lattice parameters for crystalline krypton along its melting line are reported with an estimated experimental uncertainty (r.m.s.) of 27 ppM. The x-ray data span the range of melting temperatures from 127.3 to 138.9°K. These data and similarly precise melting line lattice parameters for argon which have already been reported are used to obtain values for (∂ P/∂ T)/sub v/. These span the range of volumes $\geqq$ 1 cm³/mol below the triple point volume, and most are ten times more precise than any values reported heretofore. They are in excellent agreement with existing isochoric equation of state data and yield new high precision values for x-ray compressibilities at high temperatures along the sublimation curves of argon and krypton. Values for the isochoric temperature derivative of the isothermal bulk modulus are also obtained. 6 figures, 4 tables.

5143 **(DOE/TIC—11361) Fundamental theory and techniques of Raman spectroscopy.** Begun, G.M. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01.

The text for a lecture on Raman spectroscopy is presented.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 4617, 4620, 5125, 5140, 5141

5144 **Refinement of the crystal structure of quinolinic acid at 100 K with neutron diffraction data.** Takusagawa, F.; Koetzle, T.F. (Brookhaven National Lab., Upton, NY). *DKActa Crystallographica, Section B. Structural Crystallography and Crystal Chemistry (Denmark) Continues in part Acta Crystallographica;* **34**: 1149-1154(1978).

The crystal structure of quinolinic acid (pyridine-2,3-dicarboxylic acid: $C_7H_5NO_4$) has been refined, based upon neutron diffraction data measured at 100 K. Crystal data: space group $P2_1/c$; a = 7.415(5), b = 12.396(9), c = 7.826(6) A, β = 117.05(4)°, Z = 4. The final unweighted R value based on F^2 is 0.048 for all 1643 unique reflections, and bond distances have been determined with precision better than 0.003 A. The major temperature dependence in the cell constants is observed for the b axis, which is perpendicular to the molecular plants. Rigid-body analyses of the thermal parameters determined here at 100 K and those found in a prior study at 297 K indicate that the translational motion changes with temperature more along the b axis than in other directions. Significant differences between the structure at 100 and 297 K are observed in the intramolecular O...H...O hydrogen bond, where the H atom shifts towards the midpoint of the bond when the crystal is cooled. This temperature effect is discussed in the light of results of the rigid-body thermalmotion analyses. 5 figures, 4 tables.

4005 Photochemistry

5145 **(DOE/ER/10396—2) Studies of free radicals by ultraviolet excimer laser photolysis. Progress report, 1 April 1980-1 November 1980.** Leone, S.R. (Colorado Univ., Boulder (USA)). 1980. Contract AC02-79ER10396. 12p. NTIS, PC A02/MF A01.

An experimental technique has been developed to produce and directly study vibrationally excited free radicals. Pulses of light from an ultraviolet excimer laser are used to photodissociate small molecules to generate free radicals with high internal excitation. The radicals are detected directly by the technique of time and wavelength-resolved infrared emission spectroscopy using a background-limited copper-doped germanium infrared detector. New results have been obtained on the CH_3 radical. A complete spectrum of the CH_3 umbrella band reveals for the first time accurate positions of the vibrational progression in this band. Photofragmentation of $(CH_3)_2Hg$ has yielded detailed information on the vibrational distribution, rotational temperature, and deactivation rates of the CH_3 stretch mode. A technique to study chemical chain reactions using low power, radical-specific, laser initiation and realtime kinetics detection had previously been demonstrated. The results provide a general method to study a large number of chain reaction combustion systems in greater detail. New results on more complex chain reactions such as Cl_2/butane reveal that highly detailed infrared emission spectra of various products of the chain and their time evolution is possible. Partitioning of energy between vibrational degrees of freedom and translational heating is obtained over the course of the combustion.

5146 **(DOE/ET/33056—15) Nonequilibrium photochemical reactions induced by lasers. Final report.** Steinfeld, J.I. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 7 Apr 1980. Contract AS02-76ET33056. 8p. NTIS, PC A02/MF A01.

The work carried out under this contract has addressed two principal issues: how the multiple infrared photon excitation process is initiated in a polyatomic molecule; and how to understand the chemical processes which ensue following such excitation. The first question has been addressed by the technique of diode-infrared laser-double resonance. Sulfur hexafluoride was chosen as the test molecule. Power broadening induced by the pump beam, transitions in the 2 ν_3 reverse arrow ν_3 manifold, and relaxations within the ν_3 vibrational level brought about by collisions between SF_6 and other molecules of SF_6, He, and CH_3F have been observed. The results indicate that rotational broadening of the excited-state absorption band envelopes may play a significant role in anharmonicity compensation, and that rotational relaxation proceeds mainly by collisions which reorient the angular momentum with respect to the internal coordinates of the SF_6 molecules, but leave the total J quantum number nearly unchanged. The double resonance signals have now been satisfactorily interpreted in terms of standard 2- and 3-level models, with the possible exception of some collisional redistribution of intensity. From the excited-state-absorption signals, some of the spectroscopic parameters of the $(n > 1)\nu_3$ levels can be determined. The infrared photochemistry of a series of chloro-substituted ethylenes has been studied. The primary reaction mode has been established as 3-center elimination of HCl, leading in some cases to a transient vinylidenecarbene ($R_2C{=}C{:}$) intermediate. The kinetics can be fully accounted for in terms of RRKM unimolecular rate theory.

5147 **(LA-UR—80-2798) Ultraviolet laser photochemistry of halogenated methanes.** Wampler, F.B.; Tiee, J.J.; Oldenborg, R.C. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 15p. (CONF-801139—1). NTIS, PC A02/MF A01.

From Electro-optics/laser conference; Boston, MA, USA (19 Nov 1980).

The uv laser photochemistry of CF_2Br_2, CCl_4, CCl_3F, and CCl_2F_2 was studied. The emission spectra and dynamics of the halogenated alkyl radicals formed from the excimer laser photolysis of these compounds are reported. Possible mechanistic routes are also examined. Some results are given from studies on the kinetics of CCl, CCl_2, and CClF ground state radicals with various reactants.

5148 **(LBL—11666) Photochemistry and kinetics of gas phase reactions involving HO and Cl radicals.** Nelson, H.H. (California Univ., Berkeley (USA)). Nov 1980. Contract W-7405-ENG-48. 155p. NTIS, PC A08/MF A01.

Thesis.

The kinetics of the reaction of the HO radical with HNO_3 and H_2O_2, the kinetics of Cl atom reactions with ClNO and $ClNO_2$, and the photochemistry of $ClNO_2$ and $ClONO_2$ were examined. The ultraviolet absorption cross sections of HNO_3 and $ClNO_2$ were also determined as part of the kinetics work. The rate constant for the reaction of HO with HNO_3 at room temperature was measured to be (8.2 +- 1.8) x 10^{-14} cm^3 $molecule^{-1}$ s^{-1}, where the uncertainty reported here and in all cases reflects twice the experimental standard deviation plus an estimate of systematic errors. The rate constant for the reaction HO + H_2O_2 was measured as (1.57 +- 0.23) x 10^{-12} cm^3 $molecule^{-1}$ s^{-1}. This agrees well with the two latest determinations and serves as a calibration of the experimental apparatus used. The Cl + ClNO reaction rate constant was determined to be (1.65 +- 0.32) x 10^{-11} cm^3 $molecule^{-1}$ s^{-1}. The rate constant for the reaction of Cl + $ClNO_2$ was found to be (5.05 +- 0.75) x 10^{-12} cm^3 $molecule^{-1}$ s^{-1}. This is the first direct measurement of this rate constant. The photodissociation of $ClNO_2$ was studied in great detail. The absorption cross sections were measured in the ultraviolet and found to be substantially lower than the literature values in the Cl_2 absorption region (300 to 360 nm). Two product channels were investigated; products representative of the two channels were Cl and O atoms. Absolute calibration for the product detection systems was provided by Cl_2 and NO_2 photolysis respectively. The quantum uields measured for photolysis at 350 nm, calcualted using the absorption spectrum measured in this work, are: 0.93 +- 0.1 for Cl and ≦ 0.025 for O. An upper limit of 0.1 was measured for the O atom channel in $ClOHO_2$ photolysis.

5149 **Carbanion photochemistry. 3. Electron transfer and radical-anion control in the photochemistry of triphenylmethyl anion.** Tolbert, L.M. (Univ. of Kentucky, Lexington). *USJournal of The American Chemical Society (U.S.);* **102**: No. 22, 6808-6813(22 Oct 1980).

On the basis of concentration and competition studies, the photomethylation of triphenylmethyl anion in dimethyl sulfoxide is shown to involve the reaction of methyl radical with triphenylmethyl anion to yield the radical anions of 1,1,1-triphenylethane and 3-(diphenylmethylene)-6-methyl-1,4-cyclohexadiene. However, there are no chain-carrying steps as there are for typical S/sub RN/1 reactions. The intervention of radical anions produces the unconventional product of para alkylation, but the reaction is dominated by the bond strength of the newly formed bond as indexed by pK/sub a/.

5150 **Photophysical properties of zinc and magnesium tris(pyrochlorophyllide a) 1,1,1-tris(hydroxymethyl)ethane triesters.** Yuen, M.J.; Closs, G.L.; Katz, J.J.; Roper, J.A.; Wasielewski, M.R.; Hindman, J.C. (Argonne National Lab., IL). *USProceedings of the National Academy of Sciences of the United States of America (U.S.);* 77: No. 10, 5598-5601(Oct 1980).

The zinc and magnesium tris(pyrochlorophyllide a) 1,1,1-tris(hydroxymethyl)ethane triesters have properties that are very similar to those exhibited by pairs of pyrochlorophyll a or chlorophyll a linked by ethylene glycol through their propionic acid side chains. In the open configuration, the fluorescence lifetimes and emission spectra of the triesters resemble those of chlorophyll a monomers. However, the triesters have a mechanism for energy dissipation not present in monomeric chlorophyll a, which prevents the build-up of significant concentrations of molecules in S_1 states. Optical pumping of these compounds in their folded configuration results in the formation of high concentrations of molecules in S_1 states and in laser light emission, which originates from the two folded macrocycles. The optical data indicate that efficient energy transfer occurs from the open to the folded configurations.

4006 Radiation Chemistry

5151 **Electron spin resonance studies of silver atom solvation in ethanol-water mixtures. Evidence for preferential solvation.** Li, A.S.W.; Kevan, L. (Wayne State Univ., Detroit, MI). *USJournal of Physical Chemistry, The (U.S.);* **84**: No. 22, 2862-2866(30 Oct 1980).

Frozen solutions of silver perchlorate exposed to ^{60}Co γ irradiation at 4 K form silver atoms by reaction of radiation-produced electrons with the silver ion. At 4 K the silver atoms are initially produced in a nonequilibrium or presolvated state, and upon brief warming to 77 K the first solvation shell geometry changes to produce an equilibrium or solvated silver atom. The presolvated and solvated silver atoms in water and ethanol matrices are characterized by different isotropic hyperfine couplings and line widths measured by electron spin resonance. We have investigated silver atoms in water-ethanol mixtures to search for preferential solvation effects. From 0 to 13 mol % ethanol the presolvated silver atom formed at 4 K exhibits parameters characteristic of a water environment. At 13 mol % the parameters suddenly change to those characteristic of an ethanol environment. This suggests that the original silver ion undergoes a drastic change in its first solvation shell at 13 mol % ethanol. This dramatic change appears to corrleate with the minimum in the excess enthalpy of mixing of ethanol and water vs ethanol mole percent. Further solvation changes occur on thermal annealing the silver atoms at 77 K.

5152 **Phase transitions and radiation sensitivity of choline chloride, bromide and iodide.** Petrouleas, V.; Nath, A.; Lemmon, R.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *GBRadiation Physics and Chemistry (England);* **16**: No. 2, 113-117(1980).

The organic salt choline chloride exists in two crystalline polymorphs. One (α-form) which is present at ambient temperature, is extraordinarily sensitive to ionizing radiation. The other (β-form), which exists above 78°C, is radiation stable. The present work shows that radiation sensitivity increases rapidly above 25°C, but reaches a maximum around 65°C, well below the α- to β- crystal phase transition. This behavior is correlated with the onset of various rotational motions that are indicated by recent NMR studies. It has also been found that H atom irradiations of the β-form, and of the radiation stable choline iodide, produce as much decomposition as in the α-form, a result that is in accord with previously published theories of the mechanism of the α-form's unique radiolysis.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 5135, 5348, 5349, 5351, 5352, 5353, 5354, 5355, 5356, 5357, 5358, 5359, 5360, 5364, 5366, 5367, 5370, 5376, 5379, 5383, 5388, 5389, 5392, 5393, 5394, 5395, 5396, 5397, 5398, 5408, 5409, 5412, 5446, 5449

5153 **(DOE/ER/03283—31) Studies in hot atom and radiation chemistry. Progress report, December 1, 1979-November 30, 1980.** Koski, W.S. (Johns Hopkins Univ., Baltimore, MD (USA). Hospital). Sep 1980. Contract AS02-76ER03283. 15p. NTIS, PC A02/MF A01.

/sub nThe results on the reactive scattering of B^+ (^3P/sub u/) by D_2 has been published and a corresponding study on the ground state (^1S/sub g/) of B^+ has been submitted for publication. The ionic aspect of the Br-ethane hot atom system is being investigated using beam techniques. I^+ is found that there is no direct reaction of Br^+ with ethane which can explain the thermal ionic yield of CH_3Br reported by hot atom chemists for the Br-ethane hot atom system. Likewise, no satisfactory explanation exists for the dependence of the thermal ionic yield of CH_3Br on moderator mole

fraction. Studies of the collisions of Br^+ with Kr (which is used as a moderator in hot atom systems) shows that ions such as $BrKr^+$ are formed. Electron irradiation of CH_3Br-Kr mixtures shows that CH_3BrKr^+ is formed in good yield. Electron irradiation of Br_2-Kr mixtures shows that ions such as Br(Kr)/sub n/$^+$ are formed. Such ions can be produced in the Kr moderated Br-ethane hot atom system and can explain the thermal ionic yield of CH_3Br and its dependence on Kr pressure.

5154 **(ORNL/TM—7359) Feasibility study for the oxidation of Am(III) by photolysis.** Friedman, H.A. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01.

The results of a literature survey indicate that Am(III) may be light sensitive because it is characteristically similar to neptunium and plutonium. The redox potentials of americium are greater than the other two elements (which will probably make it more difficult to photolyze), and it does not absorb appreciable uv above 240 nm. A lamp whose emission is in the far uv region, a Suprasil quartz spectrophotometric-photolysis cell, and possibly an inert-atmosphere containment jacket would be needed to photolyze Am(III) in the glove box.

5155 **Effect of target-gas purity on the chemical form of F-18 during ^{18}F-F_2 production using the neon/fluorine target.** Bida, G.T.; Ehrenkaufer, R.L.; Wolf, A.P.; Fowler, J.S.; MacGregor, R.R.; Ruth, T.J. (Brookhaven National Lab., Upton, NY). *USJournal of Nuclear Medicine (U.S.);* **21**: No. 8, 758-762(Aug 1980).

From 28. annual meeting of the Society of Nuclear Medicine; Las Vegas, NV, USA (16 Jun 1981).

Irradiation of gas mixtures of F_2/Ne ($^{20}Ne \rightarrow {}^{18}F$) which contained percent levels (> 0.1%) of N_2, CO_2, or CF_4 resulted in the production of unacceptable levels of F-18-labeled NF_3 and CF_4 at the expense of ^{18}F-F_2. Analytical gas chromatographic methods have been devised to determine contaminant levels in the target gas as well as in the products arising from them. Commercial mixtures of 1% F_2/Ne, pure F_2, and neon have been analyzed for contaminants (N_2, O_2, CO, CO_2, and CF_4) and found to vary widely in the levels of these impurities from batch to batch. The N_2 levels in the 1% F_2/Ne mixtures varied from 0.039 to 0.49%, and the CO_2 levels from 0.028 to 0.13%. No detectable impurities were found in the neon (Research Purity), but F_2 was found to contain ~ 11% CF_4. Reproducibly high yields of ^{18}F-F_2 are obtained if the levels of N_2, CO_2, and CF_4 in the final target gas mixture are < 0.01% and carrier F_2 is ~ 0.1%. Hydrocarbons and CO were not detected in our gas mixtures, but would also be expected to decrease yields of ^{18}F-F_2.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

5156 **(SAND—80-8751) Chemical element diffusion factors for use in the conserved scalar approach to diffusion flame modeling.** Mitchell, R.E. (Sandia National Labs., Livermore, CA (USA)). Oct 1980. Contract AC04-76DP00789. 150p. (CONF-8010104—3). NTIS, PC A07/MF A01.

From Western states section of the combustion institute fall 1980 meeting; Los Angeles, CA, USA (20 Oct 1980).

A theoretical reacting flow model which considers the effects of finite-rate chemistry and composition- and temperature-dependent thermodynamic and transport properties was used to determine the velocity, temperature and species concentration profiles established in a laminar methane-air diffusion flame. The model was validated by comparison of calculated and experimentally obtained profiles. The calculated molecular species concentration profiles were used to determine those of the chemical element mass fractions. Dissimilarity in the distributions of normalized conserved scalars based on the C, H, O and N chemical elements mass fractions was used to illustrate the effect of differential species diffusion. Effective diffusion factors of the chemical elements were determined from the distributions of the molecular species. These effective elemental diffusion factors are independent of temperature, pressure and composition and allow the conserved scalar approach to diffusion flame modeling to be employed without the need to assume equal diffusion coefficients for all species.

42 ENGINEERING

4202 Facilities And Equipment

5157 **(BDX—613-2390) Deburring: an annotated bibliography. Volume VI.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). Jul 1980. Contract AC04-76DP00613. 41p. NTIS, PC A03/MF A01.

An annotated summary of 138 articles and publications on burrs, burr prevention and deburring is presented. Thirty-seven deburring processes are listed. Entries cited include English, Russian, French, Japanese, and German language articles. Entries are indexed by deburring processes, author, and language. Indexes also indicate which references discuss equipment and tooling, how to use a proces economics, burr properties, and how to design to minimize burr problems. Research studies are identified as are the materials deburred.

5158 **(LA—8572-MS) Permeation of protective garment material by liquid halogenated ethanes and a polychlorinated biphenyl.** Weeks, R.W. Jr.; McLeod, M.J. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 47p. NTIS, PC A03/MF A01.

The halogenated ethanes 1,2-dichloroethane; 1,1,1-trichlorethane; and 1,1,2-trichlorethane are used as chemical intermediates and in metal working operations, and polychlorinated biphenyls (PCBs) have in the past been used by the tens of millions of pounds in various roles in American industry. Because of the widespread use and hazardous or potentially carcinogenic nature of these compounds, a study was performed to determine the degree of protection which was afforded against these compounds by certain protective garment materials. The materials evaluated in these studies have included: butyl rubber, milled nitrile rubber, neoprene rubber latex, nitrile rubber latex, polyethylene, poly(vinyl alcohol), surgical rubber latex, Teflon, and Viton as well as the following composite or multilayered materials: butyl-coated nylon, polyethylene-coated Tyvek, polyurethane-coated nylon, and poly(vinyl chloride)-coated nylon. The breakthrough time at which each liquid phase compound permeated these materials was studied by the time lag method. For the noncomposite materials, the results of these breakthrough studies were correlated with their equilibrium weight changes following immersion in the test liquids. Results of these studies have shown that most materials currently used in the construction of protective garment material in the United States are of a generally unsatisfactory nature with respect to protecting the worker against the halogenated ethanes and the PCB used in this study.

5159 **(LA-UR—80-2813) Pneumo MSG-325 Lathe.** Rhorer, R.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-8010120—2). NTIS, PC A02/MF A01.

From IMOG machine tool subgroup meeting; Livermore, CA, USA (7 Oct 1980).

The LASL Shop Department has recently installed a Pneumo MSG-325 two-axis contouring lathe. This one-microinch resolution lathe, which utilizes both air-bearing spindle and air bearing slide ways, was purchased primarily for miniature work, but can also single point diamond turn metal optics.

5160 **(LA-UR—80-2847) Investigation of air cleaning system response to accident conditions.** Andrae, R.W.; Bolstad, J.W.; Foster, R.D.; Gregory, W.S.; Horak, H.L.; Idar, E.S.; Martin, R.A.; Ricketts, C.I.; Smith, P.R.; Tang, P.K. (Los Alamos Scientific Lab., NM (USA); New Mexico State Univ., Las Cruces (USA)). 1980. Contract W-7405-ENG-36. 23p. (CONF-8010119—1). NTIS, PC A02/MF A01.

From 16. DOE nuclear cleaning conference; Boston, MA, USA (Oct 1980).

Air cleaning system response to the stress of accident conditions are being investigated. A program overview and hghlight recent results of our investigation are presented. The program includes both analytical and experimental investigations. Computer codes for predicting effects of tornados, explosions, fires, and mate-

rial transport are described. The test facilities used to obtain supportive experimental data to define structural integrity and confinement effectiveness of ventilation system components are described. Examples of experimental results for code verification, blower response to tornado transients, and filter response to tornado and explosion transients are reported.

5161 **(SAND—80-2185C) Insert type milling cutter evaluation.** Gonzales, J.F. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 12p. (CONF-8010120—1). NTIS, PC A02/MF A01.

From IMOG machine tool subgroup meeting; Livermore, CA, USA (7 Oct 1980).

The purpose of this test was to obtain data on the major manufacturers of Insert Type Milling Cutters. Each manufacturers' representative was contacted and informed of the pending test. They were told of the type of material to be machined and the parameters of the operation. The manufacturers were asked to supply us with a cutter and inserts; they recommended to meet our needs for machining 304 stainless steel as specified in the Machining Data Handbook. Only three manufacturers responded; Carboloy, Kennametal, and Valenite., and cutters from each were tested. Each cutter was exposed to the exact same conditions, varying only where the cutter parameters dictated, to assure equality. The test results show that the Valenite cutter and inserts would require the least amount of maintenance, the greatest amount of wear life, and the best finishes. This cutter also required the least amount of horsepower in each cut. This is also advantageous from a power consumption outlook. The Valenite used a maximum of 8.01 Hp, which is 5968.48 W of power, where the Kennametal cutter used a maximum of 17.443 Hp, which is 13,012.48 W of power consumed. This is almost two times the energy consumption.

5162 **(UCRL—52960(Supp.1)) Technology of machine tools. Supplement 1. Testing of accuracy of NC machine tools.** Tlusty, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1980. Contract W-7405-ENG-48. 95p. NTIS, PC A05/MF A01.

The state of the art of accuracy testing, a concept, basic explanations, definitions, methods, and a list of tests are presented here as a general proposal for a standard test that corresponds to the present state of the art of metrology of numerically controlled machine tools. The three main basic features of this system are: it is a non-machining system of tests which could be called tracing of a universal master part; it is an essentially non-statistical test which assumes that the individual sources of errors and their motions can be, to a reasonable extent, isolated and systematically combined; and the tests are formulated from the user's and not from the builder's point of view, and they are related to the accuracy of the workpiece. The basic measurements of translational and rotational errors, the effects of machine deformation and of temperature, and the tolerances permitted in milling, boring, and turning machine operations are discussed. (LCL)

5163 **Torque-balanced vibrationless rotary coupling.** Miller, D.M. (to Dept. of Energy). US Patent 4,203,303. 20 May 1980. Filed date 28 Jul 1978. 6p.

PAT-APPL-929,134.

This disclosure describes a torque-balanced vibrationless rotary coupling for transmitting rotary motion without unwanted vibration into the spindle of a machine tool. A drive member drives a driven member using flexible connecting loops which are connected tangentially and at diametrically opposite connecting points through a free floating ring.

5164 **Superconducting articles of manufacture and method of producing same.** Newkirk, L.R.; Valencia, F.A. (to Dept. of Energy). US Patent 4,202,931. 13 May 1980. Filed date 23 Sep 1974. 8p.

PAT-APPL-508,586.

Bulk coatings of Nb_3Ge with high superconducting transition temperatures bonded to metallic substrates and a chemical vapor deposition method for producing such coatings on metallic substrates are disclosed. In accordance with the method, a Nb_3Ge coating having a transition temperature in excess of 21.5 K may be tightly bonded to a copper substrate.

5165 **Method for forming or bonding a liner.** Prevender, T.S. (to Dept. of Energy). US Patent 4,198,740. 22 Apr 1980. Filed date 24 Jul 1978. 4p.

PAT-APPL-927,237.

A process and means are provided for forming or bonding a liner to a shell or element wherein the liner is filled with or immersed in water and a portion of the water is frozen.

5166 **Alignment fixture.** Bell, G.C.; Gibson, O.T. (to Dept. of Energy). US Patent 4,196,522. 8 Apr 1980. Filed date 30 Apr 1979. 4p.

PAT-APPL-34,790.

A part alignment fixture is provided which may be used for precise variable lateral and tilt alignment relative to the fixture base of various shaped parts. The fixture may be used as a part holder for machining or inspection of parts or alignment of parts during assembly and the like. The fixture includes a precisely machined diameter disc-shaped hub adapted to receive the part to be aligned. The hub is nested in a guide plate which is adapted to carry two oppositely disposed pairs of positioning wedges so that the wedges may be reciprocatively positioned by means of respective micrometer screws. The sloping faces of the wedges contact the hub at respective quadrants of the hub periphery. The lateral position of the hub relative to the guide plate is adjusted by positioning the wedges with the associated micrometer screws. The tilt of the part is adjusted relative to a base plate, to which the guide plate is pivotally connected by means of a holding plate. Two pairs of oppositely disposed wedges are mounted for reciprocative lateral positioning by means of separate micrometer screws between flanges of the guide plate and the base plate. Once the wedges are positioned to achieve the proper tilt of the part or hub on which the part is mounted relative to the base plate, the fixture may be bolted to a machining, inspection, or assembly device.

5167 **Acoustic emission intrusion detector.** Carver, D.W.; Whittaker, J.W. (to Dept. of Energy). US Patent 4,196,423. 1 Apr 1980. Filed date 9 Aug 1978. 6p.

PAT-APPL-932,150.

An intrusion detector is provided for detecting a forcible entry into a secured structure while minimizing false alarms. The detector uses a piezoelectric crystal transducer to sense acoustic emissions. The transducer output is amplified by a selectable gain amplifier to control the sensitivity. The rectified output of the amplifier is applied to a Schmitt trigger circuit having a preselected threshold level to provide amplitude discrimination. Timing circuitry is provided which is activated by successive pulses from the Schmitt trigger which lie within a selected time frame for frequency discrimination. Detected signals having proper amplitude and frequency trigger an alarm within the first complete cycle time of a detected acoustical disturbance signal.

5168 **Valve.** Cho, N. (to Dept. of Energy). US Patent 4,195,813. 1 Apr 1980. Filed date 15 May 1972. 4p.

PAT-APPL-253,260.

A positive acting valve suitable for operation in a corrosive environment is provided. The valve includes a hollow valve body defining an open-ended bore for receiving two, axially aligned, spaced-apart, cylindrical inserts. One insert, designated the seat insert, terminates inside the valve body in an annular face which lies within plane normal to the axis of the two inserts. An elastomeric O-ring seal is disposed in a groove extending about the annular face. The other insert, designated the wedge insert, terminates inside the valve body in at least two surfaces oppositely inclined with respect to each other and with respect to a plane normal to the axis of the two inserts. An elongated reciprocable gate, movable between the two inserts along a path normal to the axis of the two inserts, has a first flat face portion disposed adjacent and parallel to the annular face of the seat insert. The gate has a second face portion opposite to the first face portion provided with at least two oppositely inclined surfaces for mating with respective inclined surfaces of the wedge insert. An opening is provided through the gate which registers with a flow passage through the two inserts when the valve is open. Interaction of the gate against the O-ring seal in the seat insert at the limits of gate displacement where it reaches its respective fully open and fully closed positions.

5169 **Resistive coating for current conductors in cryogenic applications.** Hirayama, C.; Wagner, G.R. (to Dept. of Energy). US Patent Application 115,866. 28 Jan 1980. 9p.

This invention relates to a resistive or semiconducting coating for use on current conductors in cryogenic applications. This includes copper-clad superconductor wire, copper wire used for stabilizing superconductor magnets, and for hyperconductors. The coating is a film of cuprous sulfide (Cu_2S) that has been found not to degrade the properties of the conductors. It is very adherent to the respective conductors and satisfies the mechanical, thermal, and electrical requirements of coatings for the conductors.

5170 **Method and apparatus for forming flues on tubular stock.** Beck, D.E.; Carson, C. (to Dept. of Energy). US Patent Application 106,131. 21 Dec 1979. 11p.

The present invention is directed to a die mechanism utilized for forming flues on long, relatively narrow tubular stock. These flues are formed by displacing a die from within the tubulai stock through perforations previously drilled through the tubular stock at selected locations. The drawing of the die upsets the material to form the flue of the desired configuration. The die is provided with a lubricating system which enables the lubricant to be dispensed uniformly about the entire periphery of the die in contact with the material being upset so as to assure the formation of the flues. Further, the lubricant is dispensed from within the die onto the peripheral surface of the latter at pressures in the range of about 2000 to 10,000 psi so as to assure the adequate lubrication of the die during the drawing operation. By injecting the lubricant at such high pressures, low viscosity liquid, such as water and/or alcohol, may be efficiently used as a lubricant and also provides a mechanism by which the lubricant may be evaporated from the surface of the flues at ambient conditions so as to negate the cleansing operations previously required prior to joining the flues to other conduit mechanisms by fusion welding and the like.

5171 **Sequenced drive for rotary valves.** Mittell, L.C. (to Dept. of Energy). US Patent Application 106,130. 21 Dec 1979. 11p.

A sequenced drive for rotary valves which provides the benefits of applying rotary and linear motions to the movable sealing element of the valve is described. The sequenced drive provides a close approximation of linear motion while engaging or disengaging the movable element with the set minimizing wear and damage due to scrubbing action. The rotary motion of the drive swings the movable element out of the flowpath thus eliminating obstruction to flow through the valve.

5172 **Flash protection controller.** Galbraith, L.K. (to Dept. of Energy). US Patent Application 101,368. 7 Dec 1979. 19p.

A controller provides a high voltage to maintain an electro-optic shutter in a transparent condition until a flash of light which would be harmful to personnel is sensed by a phototransistor. The controller then shorts the shutter to ground to minimize light transmission to the user and maintains light transmision at the pre-flash level for a predetermined time to allow the flash to subside. A log converter and differential trigger circuit keep the controller from being triggered by other light flashes which are not dangerous.

5173 **Method for forming low-resistance ohmic contacts on semiconducting oxides.** Narayan, J. (to Dept. of Energy). US Patent Application 080,725. 1 Oct 1979. 14p.

The invention provides a new method for the formation of high-quality ohmic contacts on wide-band-gap semiconducting oxides. As exemplified by the formation of an ohmic contact on n-type $BaTiO_3$ containing a p-n junction, the invention entails depositing a film of a metallic electroding material on the $BaTiO_3$ surface and irradiating the film with a Q-switched laser pulse effecting complete melting of the film and localized melting of the surface layer of oxide immediately underlying the film. The resulting solidified metallic contact is ohmic, has unusually low contact resistance, and is thermally stable, even at elevated temmperatures. The contact does not require cleaning before attachment of any suitable electrical lead. This method is safe, rapid, reproducible, and relatively inexpensive.

4203 Lasers

5174 **(BNL—28339) Three dimensional calculation of electron energy loss in a variable parameter free-electron laser.** Luccio, A.; Pellegrini, C. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 19p. NTIS, PC A02/MF A01.

The motion of an electron beam through a longitudinally varying period undulator for a single-pass free-electron laser is studied. It is shown that, under certain conditions, the electrons are trapped in an optical bucket, and deliver on the average more energy to the laser field than in constant period undulators of comparable parameters. The limits set by a finite beam emittance and energy spread are studied in detail by three-dimensional computer simulation.

5175 **(COO—4223-8) Investigation of concept of efficient short wavelength laser. Final technical report, April 1, 1977-July 31, 1979.** Piper, L.G.; Krech, R.H.; Pugh, E.; Taylor, R.L. (Physical Sciences, Inc., Woburn, MA (USA)). 1979. Contract AC02-77DP40047. 68p. NTIS, PC A05/MF A01.

The feasibility of producing an efficient, short wavelength, storage laser for ICF driven applications by making use of certain state-specific reactions of exoergic azide compounds has been investigated. The ultraviolet (~ 300 nm) photolysis of gaseous ClN_3 produced prompt emission in the red, which was attributed to the efficient formation of $ClN(b^1\Sigma^+)$ with subsequent ClN(X reverse arrow b) fluorescence. Based on these results, a small-scale laser demonstration experiment was constructed using short duration Xe flash lamps as the photolytic source. The results of this latter experiment were negative. The most plausible explanation was that the flash lamps provided sufficient far-uv radiation to dissociate and/or ionize the ClN(b) produced in the primary photolytic step. In parallel, limited experiments were performed on the rapid pyrolysis of a solid, ionic azide, NaN_3, to produce gaseous N_3 radicals and subsequent production of triplet N_2 molecules.

5176 **(DOE/DP/40008—1) Optically pumped metal vapor lasers. Final technical report, 15 Apr 1978-15 Jul 1980.** Mandl, A.; Hyman, H. (Avco-Everett Research Lab., Inc., Everett, MA (USA)). Sep 1980. Contract AC08-78DP40008. 46p. NTIS, PC A03/MF A01.

The properties of optically-excited Hg/NH_3 and Hg/ND_3 mixtures have been studied as a function of mercury pressure in the range 1 to 40 torr. At low mercury pressures, $\leqq$ 1 torr, the well-known uv emission band due to $HgNH_3^*$ is dominant; this regime has been investigated extensively over the past ten years. However, at higher pressures the uv band disappears and is replaced by a strong green emission band, centered near 500 nm. From a detailed study of the spectral and temporal characteristics of the green band, it is concluded that it arises from the formation of the $Hg_2NH_3^*$ (or $Hg_2ND_3^*$) excited molecular complex. The lifetime of this exciplex has been measured and is found to be 3.8 μsec (+-25%). Because of interest in the system as a potential energy storage laser medium, optical transmission measurements have been carried out at selected wavelengths. Net absorption has been observed across the green band at high mercury density, as well as in the uv band in the low density regime.

5177 **(LA-UR—80-3187) LASL free electron laser experiment.** Stein, W.E.; Brau, C.A.; Newnam, B.E.; Warren, R.W.; Winston, J.G. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801111—8). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

The accomplishment of a high-power, free-electron laser (FEL) is dependent on efficient transfer of electron energy to the laser electromagnetic field and efficient recovery of the remaining electron energy. Electron energy transfer to the laser field occurs in a wiggler. In the past, wigglers with a uniform period have been used. Recently, however, it has been proposed that a tapered wiggler would enhance the efficiency of energy transfer. In the Los Alamos Scientific Laboratory (LASL) experiments, the efficiency of energy transfer in tapered wigglers will be studied and recovery

of a portion of the electron energy will be investigated. First, an amplifier experiment will be performed to demonstrate efficient energy extraction and laser gain of a tapered wiggler. In the second experiment, the FEL amplifier will be converted to an oscillator by increasing the duration of the electron beam pulse and by adding laser mirrors. In the third experiment, a racetrack beam-transport system will be added to the FEL oscillator to determine the recovery efficiency of the remaining electron energy.

5178 **Method for providing mirror surfaces with protective strippable polymeric film.** Edwards, C.C.; Day, J.R. (to Dept. of Energy). US Patent 4,199,620. 22 Apr 1980. Filed date 27 Mar 1979. 6p.
PAT-APPL-24,340.

This invention is a method for forming a protective, strippable, elastomeric film on a highly reflective surface. The method is especially well suited for protecting diamond-machined metallic mirrors, which are susceptible not only to abrasion and mechanical damage but also to contamination and corrosion by various fluids. In a typical use of the invention, a diamond-machined copper mirror surface is coated uniformly with a solution comprising a completely polymerized and completely cured thermoplastic urethane elastomer dissolved in tetrahydrofuran. The applied coating is evaporated to dryness, forming a tough, adherent, impermeable, and transparent film which encapsulates dust and other particulates on the surface. The film may be left in place for many months. When desired, the film may be stripped intact, removing the entrapped particulates and leaving no residue on the mirror surface.

5179 **Lanthanum-hexaboride carbon composition for use in corrosive hydrogen-fluorine environments.** Holcombe, C.E. Jr.; Kovach, L.; Taylor, A.J. (to Dept. of Energy). US Patent Application 114,446. 22 Jan 1980. 13p.

The present invention relates to a structural composition useful in corrosive hydrogen-fluorine environments at temperatures in excess of 1400°K. The composition is formed of a isostatically pressed and sintered or a hot-pressed mixture of lanthanum hexaboride particles and about 10 to 30 vol% carbon. The lanthanum-hexaboride reacts with the high-temperature fluorine-containing gases to form an adherent layer of corrosion-inhibiting lanthanum trifluoride on exposed surfaces of the composition. The carbon in the composite significantly strengthens the composite, enhances thermal shock resistance, and significantly facilitates the machining of the composition.

5180 **Electron beam-switched discharge for rapidly pulsed lasers.** Pleasance, L.D.; Murray, J.R.; Goldhar, J.; Bradley, L.P. (to Dept. of Energy). US Patent Application 102,470. 11 Dec 1979. 27p.

A method and apparatus are designed for electrical excitation of a laser gas by application of a pulsed voltage across the gas, followed by passage of a pulsed, high energy electron beam through the gas to initiate a discharge suitable for laser excitation. This method improves upon current power conditioning techniques and is especially useful for driving rare gas halide lasers at high repetition rates.

5181 **Energy absorption circuit using a triggered spark gap.** (to Dept. of Energy). US Patent Application 101,365. 11 Dec 1979. 7p.

An energy absorption circuit for fault protection of a load pulsed by an LC-type pulse forming network (PFN) is connected at one end of the PFN opposite from the load. The circuit is comprised of a triggerable spark gap (TSG) switch and a discharge resistor connected in series across the one end of the PFN. A capacitive voltage dividing circuit and a voltage dropping resistor in series are also connected across the one end of the PFN. An intermediate voltage junction of the capacitive voltage dividing circuit is connected to the trigger electrode of the TSG switch to trigger the switch on when a reverse voltage wavefront reflected from a faulty load appears across the dropping resistor to add to the voltage of the capacitive voltage divider, thereby to arc one gap in the switch, whereupon arcing in the other gap ensues.

5182 **Ac resonant charger with charge rate unrelated to preimary power requency.** (to Dept. of Energy). US Patent Application 101,339. 7 Dec 1979. 12p.

An ac resonant charger for a capacitive load, such as a pulse forming network (PFN), is provided with a variable repetition rate unrelated to the frequency of a multi-phase ac power source by using a control unit to select and couple the phase of the power source to the resonant charger in order to charge the capacitive load with a phase that is the next to begin a half cycle. For optimum range in repetition rate and increased charging voltage, the resonant charger includes a step-up transformer and full-wave rectifier. The next phase selected may then be of either polarity, but is always selected to be of a polarity opposite the polarity of the last phase selected so that the transformer core does not saturate. Thyristors are used to select and couple the correct phase just after its zero crossover in response to a sharp pulse generated by a zero-crossover detector. The thyristor that is turned on then automatically turns off after a full half cycle of its associated phase input. A full-wave rectifier couples the secondary winding of the transformer to the load so that the load capacitance is always charged with the same polarity.

5183 **Waveform synthesizer.** Franks, L.A.; Nelson, M.A. (to Dept. of Energy). US Patent Application 101,369. 7 Dec 1979. 10p.

The invention is a method by which an optical pulse of an arbitrary but defined shape may be transformed into a virtual multitude of optical or electrical output pulse shapes. Since the method is not limited to any particular input pulse shape, the output pulse shapes that can be generated thereby are virtually unlimited. Moreover, output pulse widths as narrow as about 0.1 nsec can be readily obtained since optical pulses of less than a few picoseconds are available for use as driving pulses. The range of output pulse widths obtainable is very large, the limiting factors being the driving source energy and the particular shape of the desired output pulse.

5184 **Light modulated electron beam driven radiofrequency emitter.** Wilson, M.T.; Tallerico, P.J. (to Dept. of Energy). US Patent Application 083,484. 10 Oct 1979. 12p.

The disclosure relates to a light modulated electron beam-driven radiofrequency emitter. Pulses of light impinge on a photoemissive device which generates an electron beam having the pulse characteristics of the light. The electron beam is accelerated through a radiofrequency resonator which produces radiofrequency emission in accordance with the electron, hence, the light pulses.

5185 **XeCl avalanche discharge laser employing Ar as a diluent.** Sze, R.C. (to Dept. of Energy). US Patent Application 083,508. 10 Oct 1979. 10p.

A XeCl avalanche discharge exciplex laser which uses a gaseous lasing starting mixture of: 0.2 to 0.4% chlorine donor/2.5% to 10% Xe/97.3% to 89.6% Ar) is provided. The chlorine donor normally comprises HCl but can also comprise CCl_4 BCl_3. Use of Ar as a diluent gas reduces operating pressures over other rare gas halide lasers to near atmospheric pressure, increases output lasing power of the XeCl avalanche discharge laser by 30% to exceed KrF avalanche discharge lasing outputs, and is less expensive to operate.

5186 **(LA-UR—80-2394) FEL development program at Los Alamos Scientific Laboratory.** Warren, R.W. (Los Alamos Scientific Lab., NM (USA)). [nd]. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01.

The Los Alamos Scientific Laboratory (LASL) has embarked upon an ambitious free electron laser (FEL) research program that will last several years, and includes at least three separate experiments. The overall program is briefly discussed with emphasis on the first gain experiment involving design and construction. The practical features of the experiments and the problem areas found are described. This program uses many kinds of laser systems, but concentrates on the topics of most immediate importance, that is, 10.6-μm wavelength, good beam quality, high power, and short pulses.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 4447

5187 **(SAND—80-1515C) Variable node drag parameterization for reentry trajectory estimation.** Greene, R.W.; Williamson, W.E. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 6p. (CONF-800151—1). NTIS, PC A02/MF A01.

From Aerospace sciences meeting; St Louis, MO, USA (12 Jan 1980).

A numerical parameter optimization technique is used to determine the piecewise continuous polynomial approximation to the drag coefficient history that produces a reentry trajectory that best matches radar data in a weighted least squares sense. The drag coefficient is parameterized in terms of node point locations, and polynomial coefficients or function values at the nodes. Estimation of node locations for drag coefficient histories using simulated radar data has reduced data residuals by almost one-half through improved approximation of the sharp rise in drag coefficient caused by boundary layer transition.

5188 **Device for measuring the fluid density of a two-phase mixture.** Cole, J.H. (to Dept. of Energy). US Patent 4,196,613. 8 Apr 1980. Filed date 30 Nov 1978. 8p.

PAT-APPL-957,618.

A device for measuring the fluid density of a two-phase mixture flowing through a tubular member is described. A rotor assembly is rotatively supported within the tubular member so that it can also move axially within the tubular member. The rotor assembly is balanced against a pair of springs which exert an axial force in the opposite direction upon the rotor assembly. As a two-phase mixture flows through the tubular member it contacts the rotor assembly causing it to rotate about its axis. The rotor assembly is forced against and partially compresses the springs. Means are provided to measure the rotational speed of the rotor assembly and the linear displacement of the rotor assembly. From these measurements the fluid density of the two-phase mixture is calculated.

4205 Materials Testing

5189 **(GEPP-TIS—502) Structural integrity testing of glass-ceramic/molybdenum vacuum tube frames.** Spears, R.K. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 25 Nov 1980. Contract AC04-76DP00656. 23p. NTIS, PC A02/MF A01.

In this study, vacuum tube subassemblies made of glass-ceramic insulators sealed to inner and outer molybdenum frames were loaded in compression to failure with a tensile test machine. Several factors were varied in processing these subassemblies. These factors included etching and nonetching of molybdenum piece parts, annealing and nonannealing of subassemblies, and vapor and nonvapor honing of insulators after sealing. After failure, the subassemblies were examined for fracture patterns. In most cases, fracture started at points near the lower portion of the inner sleeve-insulator interface. More load was carried by subassemblies having molybdenum piece parts that were acid etched. No difference appeared between the strength of subassemblies having annealed and nonannealed glass-ceramic insulators. Parts with vapor-honed insulators failed at substantially lower loads.

5190 **Microradiographic microsphere manipulator.** Singleton, R.M. (to Dept. of Energy). US Patent 4,196,353. 1 Apr 1980. Filed date 24 Jan 1979. 6p.

PAT-APPL-5,948.

A method and apparatus are provided for radiographic characterization of small hollow spherical members (microspheres), constructed of either optically transparent or opaque materials. The apparatus involves a microsphere manipulator which holds a batch of microspheres between two parallel thin plastic films for contact microradiographic characterization or projection microradiography thereof. One plastic film is translated to relative to and parallel to the other to roll the microspheres through any desired angle to allow different views of the microspheres.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 5109

5191 **(DOE/CS/40023—T1) Highly efficient welding power supply. Final report, May 1, 1978-September 30, 1980.** Thommes, J.M. (Cyclomatic Industries, Inc., San Diego, CA (USA)). Sep 1980. Contract AC03-78CS40023. 97p. NTIS, PC A05/MF A01.

The results and findings of an energy efficient welding power source development project are reported. The power source developed is to be used for electric arc welding processes in which 3.5 trillion BTU of energy (1978 example year) can be saved annually. The power source development incorporates the use of switch mode power supply techniques in order to convert industrial supply mains (230/460 VAC 3 phi 60 Hz) to appropriate welding voltages and currents (up to 32 volts/up to 300 amps). A series capacitor switch mode power circuit was the circuit technique chosen in order to optimize energy efficiency, costs, reliability, size/weight, and welding performance. Test results demonstrated an effective efficiency (taking into account idle power consumption) of 80% to 91% for the energy efficient power source while the conventional types of power sources tested ranged from 41% to 74% efficiency. Line power factor was also improved for the energy efficient power source. Field tests indicated additional refinements of weld process performance and power source audible noise emission reduction could be beneficial.

5192 **(LA—8537-SR) Gyrocon Radio-Frequency-Generator project for FY-78 and -79.** Tallerico, P.J.; Rankin, J.E. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 60p. NTIS, PC A04/MF A01.

The gyrocon is a high-power, high-efficiency amplifier that operates by deflection modulation of an electron beam. The bunching is better than that in a klystron, especially for very high powers and UHF frequencies, so the overall efficiency and the maximum output power can be higher than in a klystron. The present theory includes the effects of large signals, space charge, and finite beam size. The equations of motion are relativistically correct, and the space-charge fields are correct to first order in v/c. The theory is derived and a computer code to solve these equations is discussed. The code is then used to obtain several specific examples of gyrocon designs that have significant advantages over klystrons or gridded tubes in the 0.2- to 1.0-GHz frequency range. Several embodiments of the gyrocon are possible: the radial style and the spherical style are discussed in this report. The radial style has a bender magnet to increase the deflection of the beam, whereas the spherical gyrocon does not employ the bender magnet. The optimum frequency range for the spherical gyrocon is from 1.0 to 2.5 GHz.

5193 **(SAND—80-2336C) Modular file-structured databasing system.** Mathey, E.L.; Stauffer, J.D. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 11p. (CONF-801150—1). NTIS, PC A02/MF A01.

From ACM Mountain Region conference; Denver, CO, USA (15 Nov 1980).

Computer aids for integrated circuit design require the manipulation of vast amounts of data. The SADIST-SLINK modular file-structured databasing system consists of a databasing primitive written in FORTRAN and a powerful surround program written in PASCAL. The modular approach is simple, cost-effective, and extremely efficient. While the system was designed to handle LSI circuit data, it is generalized and meets many needs. In addition to circuit library information, the database currently contains HELP and DOCUMENTATION files, as well as runstream files that provide operating data for a Design Executive Program. 1 figure. (RWR)

5194 **(SAND—80-2553C) SEM/EDAX analysis of PIND test failures.** Dall Porto, J.F.; Loescher, D.H.; Olson, H.C.; Plunkett, P.V. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 7p. (CONF-8004132—1). NTIS, PC A02/MF A01.

From International reliability physics symposium; Orlando, FL, USA (7 Apr 1980).

Packaged LSI and hybrid devices used in military and space applications must pass a rigorous series of screens defined by Method 5004 of Mil Standard 883B. One of these screens is the Particle Impact Noise Detection (PIND) test. We have identified the sources of these particles and have developed procedures that have increased our PIND test yield to 90% or better.

5195 **(SAND—80-2679C) Laser-annealed GaP OHMIC contacts for high-temperature devices.** Eknoyan, O.; Van der Hoeven, W.; Richardson, T.; Porter, W.A.; Coquat, J.A. (Sandia National Labs., Albuquerque, NM (USA); Texas A and M Univ., College Station (USA). Inst. for Solid-State Electronics). 1980. Contract AC04-76DP00789. 6p. (CONF-801124—25). NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

Portions of document are illegible.

The results of successful Nd:YAG laser annealed ohmic contacts on n-type GaP are reported. Comparisons on identical laser and thermal annealed contacts on the same substrates are performed. Aging investigations are also studied. The results indicate that laser annealed contacts have far superior electrical characteristics, much better surface morphology and are substantially more stable with aging than the same but thermally alloyed ones.

4210 Combustion Systems

5196 (CONF-801079—, pp V.1-V.8) **Fireside corrosion task II: evaluation of heat exchanger materials for use in a coal-fired fluidized bed combustion environment.** Clark, J.W.; Spengler, C.J. (Westinghouse Electric Corp., Pittsburgh, PA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The main objective of this program is to formulate recommendations and specifications on the use of specific alloys as in-bed and above-bed heat exchanger materials in the fireside environment of a pressurized fluidized bed coal combustor (PFBCC) based primarily on corrosion/erosion tests in the Miniplant at the Exxon Research and Engineering Company site in Linden, NJ. Another objective is to simulate under controlled pressurized conditions in the laboratory the corrosion conditions on the alloys exposed to normal and very low oxygen pressures in the presence of calcium sulfate deposits. Bayonet-type specimen probes of selected alloys were designed and fabricated for exposure in the Exxon Miniplant at probe control temperatures representative of conventional steam, advanced steam, helium and liquid metal energy conversion cycles. Corrosion/erosion testing of the air cooled, welded samples consisted of a 117-hour shakedown run followed by an incremental 1000-hour exposure. A comprehensive metallurgical analysis was performed on specimens removed at intervals from the PFBCC, including characterization of the corrosion morphology and reaction products. Selected laboratory tests were also conducted in simulated combustor gas to clarify further the possible role of $CaSO_4$ on accelerated attack observed in PFBCC environments under variable oxygen potential conditions.

5197 (CONF-801079—, pp V.9-V.13) **Fireside corrosion task 111 boiler tube materials for advanced power cycles.** Plumley, A.L.; Roczniak, W.R. (Combustion Engineering, Inc., Windsor, CT). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Selected commercial and advanced experimental materials and coatings have been evaluated under conditions simulating advanced power cycle combinations. Initial selection of alloys and coatings included known materials whose predicted 100,000 hour creep strength suggested possible service at the expected metal temperatures (1300 to 1800°F) of advanced power cycles. Selected materials were Tp 316, Sandvik 12R72, In 800H, In 802, In 617, Haynes 188, Tp 310, 671/800H. Chromium and cobalt-chromium-aluminum-yttrium diffusion coatings as well as titanium nitride and tungsten carbide plasma coatings were also evaluated. Coal feedstock selection was made on the bsis of long-range economics and geographical location of coal type. Included were coals of the following categories: Eastern bituminous, Midwestern bituminous, Western subbituminous and lignite. Four 300-hour tests were carried out while firing 40 to 50 tons of the selected coal feedstocks in the laboratory test facility. Probes containing the selected materials were exposed in the water-cooled superheater section. Field testing for periods up to 8000 hours was then carried out in the units normally utilizing the selected coals. Conclusions can be summarized: Physical, chemical, and metallurgical evaluation of laboratory specimens did not reveal accelerated wastage of the type observed on conventional superheaters operating in a metal temperature range of 1000 to 1300°F. There was, however, sufficient attack throughout the temperature range under study to provide a ranking of the alloys tested.

5198 (CONF-801079—, pp V.14-V21) **Fluidised bed combustion: corrosion/erosion tests.** Minchener, A.J. (National Coal Board, Cheltenham, England). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The Phase 1 review has indicated similar trends in alloy behaviour in the various fluidised bed combustion programmes although some differences in the extent for attack were observed. This is an encouraging finding as the results on the relatively small 0.3 m square test rig at CRE have been confirmed on larger plants both in the UK and the USA. This provides confidence in the suitability of using relatively small rigs (which are comparatively cheap to operate) for assessing the behaviour of materials in fluidised bed combustors. The nickel based alloys have generally performed poorly in plants operating with sulphur sorbent addition, often showing localised attack, while the conventional stainless steels have been much less susceptible to the corrosive effects of the bed environments especially at metal temperatures below 650°C. The oxygen electrochemical probe was operated at two levels within the bed and at one level within the free-board of the 0.3 m square fluidised bed combustor. Considerable and rapid variations in oxygen concentrations were detected dependent on the position of measurement. The results indicate that oxygen partial pressures as low as 10^{-14} atmospheres may exist and this value may represent the oxygen partial pressures within the dense phase of the bed. The higher values reflect the higher oxygen partial pressures in the bubbles passing the probe. Freeboard measurements showed a steady concentration with occasional fluctuations to lower oxygen partial pressures.

5199 (CONF-801079—, pp V.50-V.54) **Heat exchanger materials for fluidized-bed coal combustors.** Devan, J.H.; Godfrey, T.G. (Oak Ridge National Lab., TN). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Our objective is to determine the corrosion performance of heat exchanger and uncooled internal structural materials in atmospheric fluidized-bed combustors (AFBCs). Although crushed limestone is used in the fluidized bed as a sulfur absorber, the potential exists for both oxidation and sulfidation of in-bed components that operate at temperatures from 500 to 870°C. Accordingly, these studies are conducted to estimate the service lifetimes of AFBC candidate alloys under prototypic AFBC conditions. Candidate materials are exposed in AFBC test facilities under a range of conditions intended to bracket the nominal operating conditions for demonstration AFBCs anticipated in the early 1980s. Materials are then metallurgically and chemically examined to determine mechanisms of corrosion or erosion, rate of metal loss as a function of bed operating parameters, and microstructural changes that affect mechanical performance. Examination of exposed tubes after 3000- or 4500-h test intervals indicated generally low corrosion rates except for one type 316 stainless steel tube exposed for 3000 h at 850°C.

5200 (CONF-801079—, pp V.69-V.70) **Fireside corrosion task II: investigation of gas turbine materials for use in the exhaust gas from a pressurized fluidized bed coal combustor.** McCarron, R.L. (General Electric Co., Schenectady, NY). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

The objective of this program is to provide 1000-hour engineering data on the corrosion/erosion deterioration of gas turbine materials exposed to the exhaust gas from a pressurized fluidized bed combustor. Both laboratory exposure under this program and

in-plant exposure under a separate contract will be used to gather these data. Based on corrosion/erosion data obtained, an estimate of parts lives will be made for several assumed contaminant levels and operating temperatures and pressures. The program consists of two essential test phases: (1) up to 7000 hours of materials screening for corrosion in the small burner rigs operated by the Gas Turbine Products Division of GE; and (2) 1000 hours of materials testing for corrosion/erosion in a turbine test passage which has been installed in the Exxon miniplant.

5201 (CONF-801079—, pp VI.1-VI.5) **Technology for ceramic tube heat exchangers.** Ward, M.E. (Solar Turbines International, San Diego, CA). 1980.

From 5. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (6 Oct 1980).

Present gas turbines must operate with high grade fuels to avoid damage when the combustion gases are expanded through the turbine. Low grade fuels including coal can be used if the turbine is fired indirectly by the transfer of heat from the combustion gases to the compressor air by means of a heat exchanger. The new, silicon-base ceramics appear to be the only materials able to provide the strength at temperature, erosion and corrosion resistance, and thermal shock resistance required in the tubes of this heat exchanger. The program was initiated in January 1977 and was completed June 1980. The program encompassed material strength screening tests, coal environment materials interaction tests, joining technology, heat exchanger module design, and construction. The successful operation of the full size ceramic heat exchanger above 1150°C (2100°F) outlet temperatures at 689 kPa (100 psi) with firing temperatures at 1370°C (2500°F) must be considered the major achievement of this project. While not excluding other technology advancements that were made during this project, the successful operation of the full size test module demonstrates that operation of a ceramic shell and tube heat exchanger at high temperatures with large pressure differentials is mechanically and thermally feasible.

5202 **(PB—80-174055) Technology assessment report for industrial boiler applications: coal cleaning and low sulfur coal. Final report, Sep 78-Jul 79.** Buroff, J.; Hylton, B.; Keith, S.; Strauss, J.; McCandless, L. (Versar, Inc., Springfield, VA (USA)). Dec 1979. Contract EPA-68-02-2199. 762p. NTIS, PC A99/MF A01.

The report assesses the use of three pollution control technologies--low sulfur coals, physical coal cleaning (PCC), and chemical coal cleaning (CCC)--to comply with SO2 emission regulations. It is one of a series to be used in determining the technological basis for a new source performance standard for industrial boilers. Candidate systems were selected after consideration of 7 naturally occurring low sulfur coals, 5 levels of sulfur removal by PCC, and desulfurization by 11 CCC processes. The best systems of emission reduction were identified for three coals at each of five emission control levels. For regulatory purposes this assessment must be viewed as preliminary, pending results of a more extensive examination of impacts called for under Section III of the Clean Air Act Amendments.

5203 **Regeneration of lime from sulfates for fluidized-bed combustion.** Yang, R.T.; Steinberg, M. (to Dept. of Energy). US Patent 4,197,285. 8 Apr 1980. Filed date 7 Dec 1977. 6p.

PAT-APPL-858,221.

In a fluidized-bed combustor the evolving sulfur oxides are reacted with CaO to form calcium sulfate which is then decomposed in the presence of carbonaceous materials, such as the fly ash recovered from the combustion, at temperatures of about 900° to 1000°C, to regenerate lime. The regenerated lime is then recycled to the fluidized bed combustor to further react with the evolving sulfur oxides. The lime regenerated in this manner is quite effective in removing the sulfur oxides.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 4673, 4675, 4676, 4677

5204 **Initial study of the dynamic behaviour of the new Christchurch Bay Tower.** Ellis, B.R.; Jeary, A.P. (Build Res Establ, UK). pp 87-96 of Proceedings of the international conference on the behavior of offshore structures, 2nd (BOSS '79), 1979. Vol. 2. Stephens, H.S.; Knight, S.M. (eds.). Cranfield, England; British Hydromechanics Research Association (1979).

From 2. international conference on the behaviour of offshore structures; London, UK (28 Aug 1979).

The National Maritime Institute's Christchurch Bay tower was constructed at Calshot Spit and deployed in Christchurch Bay in Spring 1978. As part of their study of the dynamic behavior of structures, the Building Research Establishment in the United Kingdom was invited to monitor the behavior of the new tower. The dynamic characteristics of the tower were measured at both Calshot and Christchurch Bay, and it was found that neither soil-structure interaction nor water-structure interaction had a significant effect on the tower's behavior. 3 refs.

4240 Pollution Control Equipment

5205 **(ANL/EES-TM—104) New source performance standards for industrial boilers. Volume 2. Review of industry operating practices.** Bryan, R.J.; Weisenberg, I.J.; Wilson, K. (Pacific Environmental Services, Inc., Santa Monica, CA (USA)). Sep 1980. Contract W-31-109-ENG-38. 95p. NTIS, PC A05/MF A01.

The applicability is evaluated of several possible versions of a revised New Source Performance Standards (NSPS) for industrial boilers to boilers that are operated according to typical industry practices. A survey of operating practices is presented, and it is concluded that an NSPS that includes too high a percent removal requirement for SO_2 (90%) might be excessively costly and cause operating problems for the industrial operator. More field evaluations of low excess air and low Btu gasification are required to validate these techniques for pollution control under industrial boiler operating conditions. The cost of two small boilers with no SO_2 controls was less than one large boiler of twice the capacity with SO_2 controls. The annual cost of operating and maintaining the control system accounted for the difference.

5206 **(ORNL—5676) Scrubbing of gaseous nitrogen oxides in packed towers.** Counce, R.M. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 234p. NTIS, PC A11/MF A01.

Gaseous nitrogen oxides were scrubbed with water at 298°K and at near atmospheric pressure in towers packed with 6- and 13-mm Intalox saddles. Nitrogen oxide removal efficiencies from 55 to 97% were obtained over a wide variation of packing depths. Other studies concerning the depletion of nitrous acid in packed towers are also presented. A mathematical model was developed based on the mass-transfer information for packed towers and chemical-reaction and mechanistic phenomena specific to the NO/sub x/-HNO/sub x/-H_2O system. Calculated NO/sub x/ removal efficiencies utilizing this model agree with the observed experimental phenomena fairly closely. The model is presented and discussed along with the results of the experimental activities.

5207 **(PB—80-169386) Case study analysis of supplementary control system reliability. Final technical report.** Egan, B.; Hoffnagle, G.; Lague, J.; McCann, R.; Doucette, S. (Environmental Research and Technology, Inc., Concord, MA (USA)). Aug 1978. Contract EPA-68-02-2090. 209p. NTIS, PC A10/MF A01.

Through a supplementary control system (SCS), SO_2 emissions from a facility are temporarily curtailed when meteorological conditions conducive to high ambient SO_2 concentrations exist or are anticipated. This report describes a case study demonstration of SCS reliability analysis techniques presented in 'Technique for Supplementary Control System Reliability Analysis and Upgrading' (EPA-450/2-76 015). A user manual is also provided. A primary

objective of this study is to discuss the reliability analysis techniques and their applicability to the problem of estimating SCS reliability.

5208 (PB—80-176365) Technology assessment report for industrial boiler applications: particulate collection. Final report, Jun 78-Oct 79. Roeck, D.R.; Dennis, R. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Dec 1979. Contract EPA-68-02-2607. 305p. NTIS, PC A14/MF A01.

The report assesses applicability of particulate control technology to industrial boilers. It is one of a series to aid in determining the technological basis for a New Source Performance Standard for Industrial Boilers. It gives current and potential capabilities of alternative particulate control techniques, and identifies the cost, energy, and environmental impacts of the most promising options. Fabric filters and electrostatic precipitators (ESPs) can exceed 99% control efficiency and can be used on industrial boilers. A baghouse seems more economical for very small combustion units or to meet a very stringent emissions requirement when burning low sulfur coal.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 5597

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 5229, 5561

5209 (BNL—51270) Acceleration of polarized protons in circular accelerators. Courant, E.D.; Ruth, R.D. (Brookhaven National Lab., Upton, NY (USA)). 12 Sep 1980. Contract AC02-76CH00016. 32p. NTIS, PC A03/MF A01.

The theory of depolarization in circular accelerators is presented. The spin equation is first expressed in terms of the particle orbit and then converted to the equivalent spinor equation. The spinor equation is then solved for three different situations: (1) a beam on a flat top near a resonance, (2) uniform acceleration through an isolated resonance, and (3) a model of a fast resonance jump. Finally, the depolarization coefficient, ϵ, is calculated in terms of properties of the particle orbit and the results are applied to a calculation of depolarization in the AGS.

5210 (SLAC-PUB—2600) Problems in obtaining polarized e^+ and e^- beams and perspectives for PEP. Chao, A.W. (Stanford Linear Accelerator Center, CA (USA)). Sep 1980. Contract AC03-76SF00515. 11p. (CONF-800994—8). NTIS, PC A02/MF A01.

From International symposium on H.E. physics with polarized beams and polarized targets; Lausanne, Switzerland (25 Sep 1980).

A matrix formalism for polarization calculation, as well as its comparison with other methods, is briefly discussed. The prediction for SPEAR is compared with experimental measurements. An estimate is offered for the transverse polarization for PEP. Various schemes for obtaining the longitudinal polarization in PEP are studied.

5211 (SLAC-PUB—2631) Numerical design of electron guns and space charge limited transport systems. Herrmannsfeldt, W.B. (Stanford Linear Accelerator Center, CA (USA)). Oct 1980. Contract AC03-76SF00515. 21p. (CONF-800952—3). NTIS, PC A02/MF A01.

From International conference on charged particle optics; Giessen, F.R. Germany (8 Sep 1980).

This paper describes the capabilities and limitations of computer programs used to design electron guns and similarly space-charge limited transport systems. Examples of computer generated plots from several different types of gun problems are included.

4303 Auxiliaries And Components

5212 (BNL—28613) FASTBUS system used in a high energy experiment. Leipuner, L.B.; Fuhrmann, J.; Larsen, R. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 11p. (CONF-801103—28). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

Experiment No. 735, now being executed at the A.G.S. is implemented in FASTBUS. Briefly, this data acquisition system is designed to operate and gather data from high energy physics experiments at sub-microsecond speeds. It is a 32 bit bus system capable of operating at near-gigabit rates. The bus can be segmented with each segment operating independently when not communicating with each other. The system is based upon a very fast integrated circuit family, emitter coupled logic or ECL.

5213 (DOE/ER/01388—463) Recent improvements on generating voltmeters. Fauska, H. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1980. Contract AC06-76ER01388. 4p. (CONF-8010111—2). NTIS, PC A02/MF A01.

From Symposium of Northeastern Accelerator personnel; Madison, WI, USA (13 Oct 1980).

Design improvements in the method of readout, and the shape of rotor and stator for the generating voltmeter are described. (GHT)

5214 (FERMILAB—80/11) Fermi National Accelerator Laboratory monthly report. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1980. Contract AC02-76CH03000. 16p. NTIS, PC A02/MF A01.

A description is given of the resumption of 400 GeV accelerator operation for high-energy physics following a facility shutdown of more than four months. Ellectron cooling has been demonstrated and the results are presented. Tests of the above-ground superconducting magnet string are discussed. An experiment measuring photoproduction of charmed baryons and mesons is summarized. Manuscripts, notes, lectures and colloquia prepared or presented fom October 8 to November 14, 1980 are listed. (GHT)

5215 WNR facility - a pulsed spallation neutron source at the Los Alamos Scientific Laboratory. Russell, G.J.; Lisowski, P.W.; King, N.S.P. (Los Alamos Scientific Lab., NM (USA)). pp 1135-1140 of Compte rendu d'une conference internationale sur la physique neutronique et les donnees nucleaires pour les reacteurs et autres applications. Harwell, 25-29 Sep 1978. Paris, France; OECD (1978).

From Conference on neutron physics and other applied purposes; Harwell, UK (25 Sep 1978).

The Weapons Neutron Research facility (WNR) at the Los Alamos Scientific Laboratory is the first operating example of a new class of pulsed neutron sources using the X(p,n)Y spallation reaction. At present, up to 10 microamperes of 800-MeV protons from the Clinton P. Anderson Meson Physics Facility (LAMPF) linear accelerator bombard a Ta target to produce an intense white neutron spectrum from about 800 MeV to 100 keV. The Ta target can be coupled with CH_2 and H_2O moderators to produce neutrons of lower energy. The time structure of the WNR proton beam may be varied to optimize neutron time-of-flight (TOF) measurements covering the energy range from several hundred MeV to a few meV. The neutronics of the WNR target and target/moderator configurations have been calculated from 800 MeV to 0.5 eV. About 11 neutrons per proton are predicted for the existing Ta target. Some initial neutron TOF data are presented and compared with calculations.

5216 (LA-UR—80-2830) Rotating penning surface-plasma source for dc H^- beams. Smith, H.V. Jr.; Allison, P.; Sherman, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-801068—9). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

The possibility of using a Penning surface-plasma source (SPS) with rotating electrodes to produce dc H^- beams is investigated. In this rotating ion source (RIS), the average power density on the electrodes is reduced by magnetically confining the discharge to a small region near the emission slit while maintaining the geometry and instantaneous power density of the fixed-electrode Penning SPS. H^- beam currents (2.5 mA at 100% duty factor, 104 mA at 1.5% duty factor) and two-dimensional normalized emittances (0.036 π cm.mrad x 0.009 π cm.mrad for 40% of a 1.5-mA, dc H^- beam) similar to those of the fixed-electrode Penning SPS are produced by the uncooled RIS reported in this paper. The scaling to a 100% duty factor, fully cooled RIS is briefly discussed.

5217 **(LA-UR—80-2831) H^- beam formation from a Penning surface plasma source using circular emission-extractor electrodes.** Sherman, J.D.; Allison, P.; Smith, H.V. Jr. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-801068—10). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Circular emission-extractor electrodes are used to extract H^- ions from a Penning surface-plasma source, with the calculated space-charge limited current being observed. Emittance measurements are extended to include emittance as a function of beam fraction. Comparatively noise-free discharge voltages lead to factor of three reduction in emittance. Equal emittances in the transverse phase spaces are observed for the circular geometries.

5218 **(LA-UR—80-2841) H^- ion source research at Los Alamos.** Allison, P.; Smith, H.V. Jr.; Sherman, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-801068—7). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Up to 160 mA of H^- ions has been extracted at 20 kV from a 10 by 0.5-mm^2 slit in a Penning surface-plasma source. Typically, 70% of the beam can be transported through a bending magnet to a Faraday cup or emittance scanner. Up to 90% transmission has been observed for some neutralizing gases. Average and pulsed cesium flows from the source were measured with a surface-ionization gauge. Operating parameters of the source and measurements of the emittance are reported.

5219 **(LA-UR—80-2967) Monitors 1980: now there are two.** Grisham, D.l.; Baldwin, T.S.; Ekberg, E.L.; Lambert, J.E.; Madrid, M.A.; Tanner, R.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 16p. (CONF-801107—28). NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The Clinton P. Anderson Meson Physics Facility (LAMPF) has developed two identical remote-handling systems, Monitors I and II, that are used to repair, replace, and maintain the main proton beam line. The systems use electric master-slave manipulators to perform the required tasks using only closed-circuit television for viewing. Advances in controls and mechanical subassemblies have increased the efficiency of operation to a significant degree. Recent major emergency repair operations have further proven the versatility and reliability of the Monitor systems. There is now no doubt that the future maintenance of the vital beam line is assured. This technology should be extended to other toxic, hazardous, and/or dangerous work areas.

5220 **(LA-UR—80-3069) Heavy-ion linac for medical and scientific research.** Hamm, R.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 21p. (CONF-8010115—1). NTIS, PC A21/MF A01.

From MARIA workshop on accelerator systems for relativistic heavy ions in medical and scientific research; Edmonton, Alberta, Canada (20 Oct 1980).

The Electron Beam Ion Source (EBIS), because of its high charge state ions and pulsed operation, is ideally suited as an injector for a heavy-ion linac based on the technology being developed at the Los Alamos Scientific Laboratory (LASL) in the program to design a Pion Generator for Medical Irradiation (PIGMI). This combination would produce a small efficient heavy ion linac useful in relativistic heavy-ion research or therapy. The radio-frequency quadrupole linac (RFQ), a new, low velocity accelerating structure in use at LASL, makes this possible because it can accelerate the fully stripped ions generated in an EBIS from a very low injection energy to an energy convenient for use in a conventional linac, with almost complete capture of the ions. If the conventional linac is a high-gradient low duty-cycle structure such as the proposed PIGMI accelerator, this accelerator system thus realizes maximum use of the ions produced in the EBIS with minimum size and power consumption in the linac. This accelerator could be extended to energies useful for relativistic heavy-ion medical therapy or physics research, or could be used as an injector for a synchrotron.

5221 **(LA-UR—80-3139) Radio-frequency quadrupole linear accelerator.** Wangler, T.P.; Stokes, R.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-801111—13). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

The radio-frequency quadrupole (RFQ) is a new linear accelerator concept in which rf electric fields are used to focus, bunch, and accelerate the beam. Because the RFQ can provide strong focusing at low velocities, it can capture a high-current dc ion beam from a low-voltage source and accelerate it to an energy of 1 MeV/nucleon within a distance of a few meters. A recent experimental test at the Los Alamos Scientific Laboratory (LASL) has confirmed the expected performance of this structure and has stimulated interest in a wide variety of applications. The general properties of the RFQ are reviewed and examples of applications of this new accelerator are presented.

5222 **(LA-UR—80-3140) Performance characteristics of a 425 MHz RFQ linac.** Stovall, J.E.; Crandall, K.R.; Hamm, R.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-801111—10). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

A radio-frequency quadrupole (RFQ) focused proton linac has been developed and successfully tested at the Los Alamos Scientific Laboratory (LASL) for the purpose of evaluating its performance and applicability as a low-beta accelerator. The geometry of the structure was designed to accept a 100-keV beam, focus, bunch, and accelerate it to 640 keV in 1.1 m with a high-capture efficiency and minimum emittance growth. The accelerator test facility includes an injector, low-energy transport section for transverse matching, and a high-energy transport section for analysis of the beam properties. The accelerator cavity is exited through a manifold powered by a 450-MHz klystron. Diagnostic instrumentation was prepared to facilitate operation of the accelerator and to analyze its performance. Measurements of the beam properties are presented and compared with the expected properties resulting from numerical calculations of the beam dynamics.

5223 **(LA-UR—80-3220) NBS-LASL cw microtron.** Penner, S.; Cutler, R.I.; Debenham, D.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-801111—32). NTIS, MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

Portions of document are illegible.

The NBS-LASL racetrack microtron (RIM) is a joint research project of the National Bureau of Standards and the Los Alamos Scientific Laboratory. The project goals are to determine the feasibility of, and develop the necessary technology for building high-energy, high-current, continuous-beam (cw) electron accelerators using beam recirculation and room-temperature rf accelerating structures. To achieve these goals, a demonstration accelerator will be designed, constructed, and tested. Parameters of the demonstration RIM are: injection energy - 5 MEV; energy gain per pass -12 MeV; number of passes - 15; final beam energy - 185 MeV; maximum current 550 μA. One 450 kW cw klystron operating at 2380 MHz will supply rf power to both the injector linac and the main accelerating section of the RTM. The disk and washer standing

wave rf structure being developed at LASL will be used. SUPERFISH calculations indicate that an effective shunt impedance (ZT) of about 100 MΩ/m can be obtained. Thus, rf power dissipation of 25 kW/m results in an energy gain of more than 1.5 MeV/m. Accelerators of this type should be attractive for many applications. At beam energies above about 50 MeV, an RTM should be considerably cheaper to build and operate than a conventional pulsed rf linac of the same maximum energy and time-average beam power. In addition, the RTM provides superior beam quality and a continuous beam which is essential for nuclear physics experiments requiring time-coincidence measurements between emitted particles.

5224 **(LA-UR—80-3245) Advantages of combining an EBIS with the PIGMI technology.** Hamm, R.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801111—33). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

The Electron Beam Ion Source (EBIS) produces highly charged heavy ions by electron impact ionization of ions electrostatically trapped within a dense energetic electron beam. Because of its pulsed operation and the highly charged ions produced, the EBIS is ideally suited as an injector for a high-gradient, low duty-cycle linac such as that being developed at the Los Alamos Scientific Laboratory (LASL) in the program to design a Pion Generator for Medical Irradiation (PIGMI). This combination of new technologies would produce an efficient, small heavy ion linac useful in a variety of research and practical applications.

5225 **(LBL—11797) Charged particle identification with modules of the plastic ball.** Gutbrod, H.H.; Maier, M.R.; Ritter, H.G.; Warwick, A.I.; Weik, F.; Wieman, H.; Wolf, K.L. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 4p. (CONF-801103—20). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The low energy pion channel (LEP) at LAMPF was used to calibrate the response of modules of the Plastic Ball detector for positive pions and protons. The detection efficiency was measured at various energies. The resolution and efficiency were found to be independent of the point at which the particle entered the detector. Scattered out particles could be well detected by including neighbouring detectors in the analysis.

5226 **(UCID—18849) Microwave modes in the FXR accelerator cavity.** Kulke, B.; Kihara, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Nov 1980. Contract W-7405ENG-48. 20p. NTIS, PC A02/MF A01.

Swept-frequency, microwave transmission measurements have been carried out on a production-model, ferrite loaded FXR cavity, both with and without further loading by termination of the four ballast load and feedline ports. Modes closely corresponding to the TM_{010} and TM_{110} modes of a simple pillbox cavity have been identified at 162 MHz and 261 MHz, respectively. The Q values of these modes are inherently low (Q_0 = 16 and 50, respectively) because of the ferrite loading. Under fully terminated conditions, the Q values are too low to be measurable, that is, the modes are either totally suppressed or very heavily damped.

5227 **(UCRL—84554) RTNS-II: present status.** Heikkinen, D.W.; Logan, C.M. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Oct 1980. Contract W-7405-ENG-48. 5p. (CONF-801111—26). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

The present status of the RTNS-II facility is described and typical operating parameters are given. A brief discussion is given of the methods used in production of the TiT_2 targets as well as their performance and tritium handling at RTNS-II. The various types of non-interactive beam diagnostics presently in use at the neutron sources are outlined. The on-line computer system which provides a time history of an irradiation and records target performance is described. Examples are listed of several representative experimental programs which have been carried out thus far at RTNS-II. These include both active and passive experiments. Finally, several of the major improvements to the facility made since the beginning of the experimental program are given.

4304 Storage Rings

5228 **(BNL—28035) ISABELLE control system.** Humphrey, J.W.; Frankel, R.S.; Niederer, J.A. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 14p. (CONF-800740—23). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

Design principles for the Brookhaven ISABELLE control intersecting storage ring accelerator are described. Principal features include a locally networked console and control computer complex, a system wide process data highway, and intelligent local device controllers. Progress to date is summarized.

5229 **(BNL—28510) Polarized protons for ISABELLE.** Courant, E.D. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA)). 1980. Contract AC02-76CH00016. 7p. (CONF-800994—7). NTIS, PC A02/MF A01.

From International symposium on H.E. physics with polarized beams and polarized targets; Lausanne, Switzerland (25 Sep 1980).

Polarized proton acceleration and storage in ISABELLE (the Brookhaven 400 GeV proton collider) is possible if the injector synchrotron, the Brookhaven AGS, produces polarized beams. For polarized protons in ISABELLE, the injection energy has to be lowered to about 22 GeV, and one or two Siberian Snakes have to be installed to eliminate resonances. Magnet imperfections may still have some depolarizing effect, especially at high energies; however, if orbit errors are kept small enough, it appears that polarization can be maintained at least to 300 GeV. Either transverse or longitudinal polarization is obtainable. If polarized H ion sources with currents around 100 microamperes become available, the luminosity of ISABELLE with polarized beams is estimated to be less than an order of magnitude below that with unpolarized beams, i.e., about 10^{32} cm^{-} sec^{-1}.None

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 4859, 5212, 5225, 5632

5230 **(CONF-801103—32) Utilization of concurrently gathered pulser data for complete spectral validation of gamma-ray spectra from germanium detectors.** Johnson, L.O.; Killian, E.W.; Helmer, R.G.; Coates, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 5p. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

Some of the capabilities and limitations of using concurrently gathered pulser data for energy calibration, dead time correction, and pile-up loss correction of gamma ray spectra from germanium detectors have been investigated. This report deals with the pulser, charge injection into the charge sensitive preamplifier, hardware separation of gamma and pulser events, and analysis techniques to improve the accuracy of gamma peak area corrections from pulser data. Data are presented indicating achievable short and long term energy calibration stability of better than .01% and accuracy and rate dependent peak area loss corrections of +-1% up to 50,000 pulses per second (pps) and +-2.5% up to 100,000 pps, energy independent.

5231 (COO—4733-3, pp 27-41) **Microdosimetry at the BEVALAC.** Kliauga, P.; Rossi, H.H.; Howard, J. (Univ. of California, Berkeley). Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

The conventional wall-less counters constructed in this laboratory for neutrons and photons were inadequate for the BEVALAC particles from the point of view of spectrum distortion by the container walls. Another self-contained, semi-portable wall-less counter, dubbed the heavy ion counter was constructed for this work and was sent to the Bevalac for use at that facility. We report here the first measurements with that counter and compare these measurements with a similar counter mounted in a much larger enclosure.

5232 **(ORNL/TM—7556) Liquid argon as an electron/photon detector in the energy range of 50 MeV to 2 GeV: a Monte Carlo investigation.** Goodman, M.S.; Denis, G.; Hall, M.; Karpovsky, A.; Wilson, R.; Gabriel, T.A.; Bishop, B.L. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 27p. (CONF-801103—10). NTIS, PC A03/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

Monte Carlo techniques which have been used to study the characteristics of a proposed electron/photon detector based on the total absorption of electromagnetic showers in liquid argon have been investigated. The energy range studied was 50 MeV to 2 GeV. Results are presented on the energy and angular resolution predicted for the device, along with the detailed predictions of the transverse and longitudinal shower distributions. Comparisons are made with other photon detectors, and possible applications are discussed.

5233 **(RDT-F—3-6T(ERRATA)) Nondestructive examination (Supplement to ASME Boiler and Pressure Vessel Code, Section V), Amendment 1.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). 14 May 1980. Contract W-7405-ENG-26. 9p. RSO.

The limits of required sensitivity shall be established by placing one penetrometer of the required thickness at each end of a weld in a test radiograph. The maximum spacing between penetrometers during production radiography shall not exceed the spacing between the two penetrometers in a test radiograph that meets the requirements.

5234 **(SLAC-PUB—2620) Time-of-flight measurements.** Atwood, W.B. (Stanford Linear Accelerator Center, CA (USA)). Oct 1980. Contract AC03-76SF00515. 42p. NTIS, PC A03/MF A01.

Time of flight (TOF) measurements are used in high energy particle physics experiments to: (1) distinguish background from events and (2) identify particle types. An example of background separation is shown. These data come from a coincidence electroproduction experiment performed at SLAC. The reaction being studied was $e + p \rightarrow e' + p' + X$ where the e(p) stand for an initial and detected electron (proton) and X is a produced but undetected final state with a mass in the rho meson region. The relative time between the detection of an electron and a proton in two of the spectrometers in End Station A is plotted. Data for two different kinematic settings taken in the experiment are shown. The time resolution has been partially corrected for the various flight paths through the instruments and the difference in time resolutions between the two settings results mainly from the incompleteness of this correction. The signal height above the background depends on the time resolution, Δ tau. The chance background is proportional to the product of the electron counting rate, the proton counting rate, and Δ tau. Smaller Δ tau means that higher electron and proton counting rates may be tolerated and result in a similar signal-to-noise ratio.

5235 **(SLAC-PUB—2626) Modular stand-alone monitor and control system (SAMAC).** Kieffer, J. (Stanford Linear Accelerator Center, CA (USA)). Oct 1980. Contract AC03-76SF00515. 5p. (CONF-801103—16). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

Large high energy physics experiments require constant monitoring and control of the numerous components of the particle detector apparatus. This paper describes a basic hardware configuration which has been designed to satisfy the monitoring and control requirements of the many different experimental setups. The system is designed to operate in the stand-alone mode, and may be interfaced to a host computer via CAMAC. The entire system is modular so that it can be easily tailored to an individual experiment. The items monitored and/or controlled may include gas pressures, temperatures, magnetic fields, high and low voltages, and system status or safety information.

5236 **(SLAC-PUB—2629) High gain multigap avalanche detectors for Cerenkov ring imaging.** Gilmore, R.S.; Lavender, W.M.; Leith, D.W.G.S.; Williams, S.H. (State Univ. of New York, Stony Brook (USA)). Oct 1980. Contract AC03-76SF00515. 4p. (CONF-801103—25). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

We report on a continuing study of multigap parallel plate avalanche chambers, primarily as photoelectron detectors for use with Cerenkov ring imaging counters. By suitable control of the fields in successive gaps and by introducing screens to reduce photon feedback to the cathode the gain many be increased considerably. We have obtained gains in excess of 6×10^7 for photoelectrons with a good pulse height spectrum and expect to increase this further. We discuss the use of resistive anodes to give avalanche positions in two dimensions by charge division.

5237 **(SLAC-PUB—2635) dE/dx prototype test.** Va'vra, J.; Rust, D. (Stanford Linear Accelerator Center, CA (USA); Indiana Univ., Bloomington (USA)). Oct 1980. Contract AC03-76SF00515. 5p. (CONF-801103—15). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

A small prototype of a multiwire dE/dx detector was tested in SLAC's test beam. The basic concept of the detector was similar to the JADE drift cell design. The purpose of the test was to decide on some design parameters for a full size prototype, which is now in construction.

5238 **Method for optimizing side shielding in positron-emission tomographs and for comparing detector materials.** Derenzo, S.E. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *USJournal of Nuclear Medicine (U.S.);* **21**: No. 10, 971-977(Oct 1980).

From 28. annual meeting of the Society of Nuclear Medicine; Las Vegas, NV, USA (16 Jun 1981).

This report presents analytical formulas for the image-forming and background event rates seen by circular positron-emission tomographs with parallel side shielding. These formulas include deadtime losses, detector efficiency, coincidence resolving time, amount of activity, patient port diameter, shielding gap, and shielding depth. A figure of merit, defined in terms of these quantities, describes the signal-to-noise ratio in the reconstructed image of a 20-cm cylinder of water with uniformly dispersed activity. Results are presented for the scintillators NaI(TI), bismuth germanate (BGO), CsF, and plastic; and for Ge(Li) and wire chambers with converters. In these examples, BGO provided the best signal-to-noise for activity levels below 1000 μCi per cm, and CsF had the advantage for higher activity levels.

5239 **(RDT-F—3-6t-(4-80)(AMENDT)) Nondestructive examination (Supplement to ASME Boiler and Pressure Vessel Code, Section V), Amendment 1.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). 14 May 1980. Contract W-7405-ENG-26. 11p. RSO.

The limits of required sensitivity shall be established by placing one penetrometer of the required thickness at each end of a weld in a test radiograph. The maximum spacing between penetrometers during production radiography shall not exceed the spacing between the two penetrometers in a test radiograph that meets requirements.

5240 **Neutron quality factor measurements at the Oak Ridge National Laboratory's dosimetry applications research facility.** Sims, C.S.; Dickson, H.W.; Gilley, L.W. (Oak Ridge National Lab., TN (USA)). *GBHealth Physics (England);* **38**: No. 5, 851-853(May 1980).

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

5241 **(UCRL—52954) Characterization of errors inherent in system EMP vulnerability assessment programs.** Bevensee, R.M.; Cabayan, H.S.; Deadrick, F.J.; Martin, L.C.; Mensing, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Oct 1980. Contract W-7405-ENG-48. 253p. NTIS, PC A12/MF A01.

The overall objectives of the DNA-funded program at LLL are to provide a measure of accuracy of currently used EMP vulnerability assessment methodology. In addition, system tools are to be provided to improve the confidence in assessment efforts, which in turn will result in improved confidence in establishing hardening requirements. During Phase I, assessment techniques currently used by the EMP community are surveyed and the sources of uncertainty are identified. Typical data are presented for quantifying the major sources of uncertainty in all phases of the assessment effort. During this phase, a statistical methodology to assess the impact of uncertainty on the survivability of a system has been partially validated with a simple system test.

4403 Miscellaneous Instruments

5242 **(BNL—28660) Second coordinate readout in drift chambers by timing of the electromagnetic wave propagating along the anode wire.** Boie, R.A.; Radeka, V.; Rehak, P.; Xi, D.M. (Brookhaven National Lab., Upton, NY (USA)). Nov 1980. Contract AC02-76CH00016. 8p. (CONF-801103—27). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The feasibility of using an anode wire and surrounding electrodes in drift chambers as a transmission line for second coordinate readout has been studied. The method is based on propagation of the electromagnetic wave along the anode wire is determined by measurement, in an optimized electronic readout system, of the time difference between the arrivals of the signal to the ends of the wire. The resolution obtained on long wires ($\sim$ 2 meters) is about 2 cm FWHM for minimum ionizing particles at a gas gain of $\simeq 10^5$.

5243 **Laser cutting apparatus for nuclear core fuel subassembly.** Walch, A.P.; Caruolo, A.B. (to Dept. of Energy). US Patent Application 123,861. 22 Feb 1980. 20p.

The object of the invention is to provide a system and apparatus which employs laser cutting to disassemble a nuclear core fuel subassembly. The apparatus includes a gantry frame which straddles the core fuel subassembly, an x-carriage travelling longitudinally above the frame which carries a focus head assembly having a vertically moving carriage and a laterally moving carriage, a system of laser beam transferring and focusing mirrors carried by the x-carriage and focusing head assembly, and a shroud follower and longitudinal follower for following the shape of shroud to maintain a beam focal point fixed upon the shroud surface for accurate cutting.

5244 **Very accurate pyrometer for general laboratory use.** Storms, E.K.; Mueller, B.A. (Univ. of California, Los Alamos, NM). *USNational Bureau of Standards (U.S.), Special Publication (U.S.);* **2**: No. 561, 143-152(1979). (NBS-SP—561(Vol.1); CONF-780941—(Vol.1)).

From 10. materials research symposium; Gaithersburg, MD, USA (18 Sep 1978).

Using commercially available equipment, a photon counting pyrometer was constructed which permits temperatures from 1400 K to above 2200 K to be measured routinely to within 0.5 K and 1.0 K, respectively, of the International Practical Temperature Scale.

4404 Well Logging Instrumentation

5245 **(SAND—80-2123) Mobile digital data acquisition and recording system for geoenergy process monitoring and control.** Kimball, K.B.; Ogden, H.C. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 18p. NTIS, PC A02/MF A01.

Three mobile, general purpose data acquisition and recording systems have been built to support geoenergy field experiments. These systems were designed to record and display information from large assortments of sensors used to monitor in-situ combustion recovery or similar experiments. They provide experimenters and operations personnel with easy access to current and past data for evaluation and control of the process, and provide permanent recordings for subsequent detailed analysis. The configurations of these systems and their current capabilities are briefly described.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 5489

5246 **(LA-UR—80-2854) Numerical calculation of shock-induced initiation of detonations.** Cort, G.E.; Fu, J.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 19p. (CONF-8010121—1). NTIS, PC A02/MF A01.

From JANNAF propulsion systems hazards meeting; Monterey, CA, USA (27 Oct 1980).

The results of some numerical calculations of the impact of steel cylinders and spheres on the plastic-bonded high explosive PBX 9501 are described. The calculations were carried out by a reactive, multicomponent, two-dimensional, Eulerian hydrodynamic computer code, 2DE. The 2DE computer code is a finite difference code that uses the donor-acceptor-cell method to compute mixed cell fluxes. The mechanism of shock initiation to detonation in heterogeneous explosives is best described as local decomposition at hot spots that are formed by shock interactions with density discontinuities. The liberated energy strengthens the shock so that as it interacts with additional inhomogeneities, hotter hot spots are formed, and more of the explosive is decomposed. The shock wave grows stronger until a detonation begins. This mechanism of initiation has been described numerically by the Forest Fire burn model, which gives the rate of explosive decomposition as a function of local pressure. The parameters in the Forest Fire burn model have been developed from experiments where the induced shock approximates a plane wave and are applied, in this case, to a situation where the induced shock is a divergent wave with curvature that depends on the size and shape of the projectile. The calculated results have been compared with results from experiments involving instrumented mock and live high explosives, with projectiles of varying sizes, shapes, and velocities. We find that there is good agreement between the calculated and experimental data.

5247 **(MHSMP—80-55) Analysis of RDX and HMX in PBX 9404 by high performance liquid chromatography.** Richardson, B.R. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Nov 1980. Contract AC04-76DP00487. 12p. NTIS, PC A02/MF A01.

An analysis for the HMX and RDX contents of PBX 9404 has been developed. Instrumental parmeters, such as column type, solvent, flow rate, and method of detection are discussed. The calibration method is examined, and precision and accuracy investigated. The average percent recovery of HMX is 98.75% with a standard deviation of 0.82%; for RDX, the percent recovery is 98.66% with a standard deviation of 0.27%.

5248 **(MHSMP—80-56) RX-26-AY/AF rifle bullet tests.** Sharp, D.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Nov 1980. Contract AC04-76DP00487. 9p. NTIS, PC A02/MF A01.

A series of rifle bullet tests was performed on two explosives, RX-26-AY and RX-26-AF, using the Pantex version of the

Picatinny Arsenal Test (PA-2). With the exception of one test, both explosives displayed a relatively low sensitivity to bullet impact. However, a marked difference was noted in the average burn time duration between the two types of explosives being tested. A minor modification was made on the rifle barrel used at the test site in order to improve the sighting procedure.

5249 **(UCID—18814) Fast detonator-activated ball shutter for high explosive experiments.** McWilliams, R.A.; Von Holle, W.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Sep 1980. Contract W-7405-ENG-48. 7p. NTIS, PC A02/MF A01.

A detonator-activated ball shutter has been developed to protect the quartz windows in a 10 gm shot chamber used for optical-laser experiments on detonating high explosives.

4502 Nuclear

5250 **(RFP—3042) Review of vendor evaluation and qualification methods.** Bolander, S.; Krueckeberg, H.; Rademacher, R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 31 Mar 1980. Contract AC04-76DP03533. 105p. NTIS, PC A06/MF A01.

This report evaluates the present method that is used to rate the performances of suppliers of finished machined WR, (War Reserve), component parts for nuclear weapons and also evaluates the method by which these suppliers are initially appraised through a quality audit performed at their facility.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 5629

5251 **(EMD—78-1123) Creation of weather tapes for each of seven heat transfer climatic zones in New Mexico. Final report, July 1, 1978-December 31, 1979.** Benson, M.J.; Busch, R.D.; Dritt, J.O. (New Mexico Univ., Albuquerque (USA). New Mexico Energy Inst.). Sep 1980. 106p. New Mexico Energy Research and Development Program, Santa Fe, NM.

The objective of this study was to classify the climate of the state of New Mexico into a small number of homogeneous climatic regions, with each region based on a set of energy-related climatic elements. The most important climate elements with respect to energy studies were identified using the climatic sensitivity of the New Mexico Home Energy Analysis computer model. Statistical analysis of the data obtained led to the identification of several climate regions, each representable by one or more easily obtainable NOAA weather databases.

5252 **(PNL-SA—8785) Comparison of observed and predicted slope winds.** Horst, T.W.; Doran, J.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC06-76RL01830. 12p. (CONF-800480—6). NTIS, PC A02/MF A01.

From ASCOT program planning meeting; Gettysburg, PA, USA (15 Apr 1980).

Nocturnal drainage winds begin when air adjacent to an inclined surface flows down the slop because it is cooled more than the free air at some distance horizontally from the surface. These slope winds merge and are channeled by the topography to form the larger-scale drainage or mountain winds. This paper discusses the slope flow phase of the drainage wind. The predictions of a simple model for flow down a two-dimensional slope are compared to observations of the drainage wind obtained during the July 1979 ASCOT field study near Middletown, CA.

5253 **(UCRL—84546) Comparison of wind spectra from spatially averaged and point measurements in complex terrain.** Porch, W.M. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Sep 1980. Contract W-7405-ENG-48. 4p. (ASCOT—80-8; CONF-810306—4). NTIS, PC A02/MF A01.

From 5. symposium on turbulence, diffusion, and air pollution; Atlanta, GA, USA (9 Mar 1981).

Results are reported for two experiments in complex terrain where a single light path was used across a valley. These experiments were conducted in two regions of California during the same month on different years. The regions differed significantly in their meteorological regimes. The first experiment was conducted across a very windy pass (Patterson Pass) east of Lawrence Livermore National Laboratory (LLNL). The second experiment was conducted in a relatively low wind location (Anderson Creek) influenced by drainage wind transport of effluent from geothermal energy wells. This second study was part of the Atmospheric Studies in Complex Terrain (ASCOT). The two studies were conducted in July 1977 (Patterson Pass) and 1979 (ASCOT). Comparison of the normalized autospectral densities of the spatially averaged and point wind measurements showed similar behavior for periods longer than four hours. For periods shorter than four hours the spectra diverge with different slopes for both region's data. This divergence at this relatively low frequency was found to be associated more with wind direction than wind speed changes. This fact would be consistent with increased deviation in wind direction in complex terrain at high frequencies, drawing energy from lower frequency variability for point wind measurements. This is not reflected in the spacially averaged data over several hundred meters. Other explanations exist, but in any case, spectral comparison of point and spacially averaged wind points to wind speed and direction interaction which is peculiar to complex terrain.

5254 **Tropospheric aerosols from some major dust storms of the Southwestern United States.** Gillette, D.A. (National Center for Atmospheric Research, Boulder, CO); Clayton, R.N.; Mayeda, T.K.; Jackson, M.L.; Shridhar, K. *USJournal of Applied Meteorology (U.S.);* **17**: No. 6, 832-845(Jun 1978).

Tropospheric aerosols from major dust storms (visibility < 11 km) originating in cultivated areas of the High Plains in west central Texas and adjacent areas of New Mexico, Oklahoma and Colorado, were sampled by ground-based airturbine samplers with stacks 1 to 6 m high, by membrane filters, by airplane-borne dust samplers and by a static ground-level sampler. The particle size distributions of the aerosol dust obtained by airplane sampling fell mainly between 1 and 30 μm diameter. A bimodal size distribution occurred for the dust from ground samplers, with large concentrations in the 40 to 80 μm range as well as in the 1 to 30 μm range. Oxygen isotopic ratio values of 1 to 10 μm quartz isolated from 17 dusts collected by ground-based samplers ranged from 16.4 to 19.5%; three dusts from the airplane samplers averaged 18.2 +- 1.1%. The fine silt from eroding sandy soils, derived not only from weathering but also possibly from eolian deposition, serves as a reservoir for long range aerosol minerals, in addition to that from shales.

5002 Chemicals Monitoring And Transport

5255 **(ANL/EES-TM—111) Description, evaluation, and sensitivity analyses of principal US EPA air quality prediction models.** Greenway, A.R.; Ellis, H.M.; Deland, R.J. (Enviroplan, Inc., West Orange, NJ (USA)). Aug 1980. Contract W-31-109-ENG-38. 124p. NTIS, PC A06/MF A01.

The scientific validity of the principal assumptions used in the US Environmental Protection Agency (EPA) air pollution prediction models was reviewed. The computational assumptions and equations used in the principal EPA models were reviewed, as was the recommended applicability of these models and their performance as reported in validation and comparison studies. In addition, a sensitivity analysis of model response to input parameter changes was conducted. The performance of the CRSTER, the Urban and Rural RAM Models, and by inference the MPTER Model of the UNAMAP series was reviewed and evaluated based on available studies of the performance of these models. It is concluded that the

RAM (Urban) Model tends to overpredict the impact of sources with tall stacks, even in urban areas due to the treatment of unstable cases. The RAM (Urban) Model implicitly accounts for building-effect downwash through enhanced plume spreading rates. The CRSTER Model performs well when the ratio of stack height to receptor height is high, but leads to overpredictions when the ratio is low. This, in complex terrain cases involving moderate stack heights, the CRSTER Model tends to overpredict. A sensitivity analysis showed that the CRSTER Model is more sensitive to input parameter values than the RAM Model. The CRSTER Model is most sensitive to changes in wind speed, stack height, stack gas exit velocity and stack gas exit temperature. Thus, these parameters should be well defined. This sensitivity increases as the ratio of stack height to receptor height decreases. Since the MPTER Model has not yet been released for use by US EPA, the evaluation of this model was more limited. Since it is basically a multi-source version of the single source CRSTER Model, conclusions concerning MPTER are inferred from the CRSTER evaluations.

5256 **(DOE/TIC—3382) Carbon dioxide and climate: a bibliography.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Oct 1980. 114p. NTIS, PC A06/MF A01.

This bibliography with abstracts presents 394 citations retrieved from the Energy Data Base of the Department of Energy Technical Information Center, Oak Ridge, Tennessee. The citations cover all aspects of the climatic effects of carbon dioxide emissions to the atmosphere. These include carbon cycling, temperature effects, carbon dioxide control technologies, paleoclimatology, carbon dioxide sources and sinks, mathematical models, energy policies, greenhouse effect, and the role of the oceans and terrestrial forests.

5257 **(EPRI—EA-1595) Compound identification of atmospheric particles. Final report, October 1980.** Lichtman, D. (Wisconsin Univ., Milwaukee (USA)). Oct 1980. 35p. NTIS, PC A03/MF A01.

This study tested the usefulness of several modern surface analytic techniques for compound identification of atmospheric particles, emphasis being on sulfur species. Using scanning electron microscopy (SEM) and x-ray fluorescence (energy dispersive x-ray: EDX) morphology and bulk elemental composition measurements of individual particles were obtained. A certain amount of chemical information was obtained from the analysis of Auger electron spectroscopy (AES) sulfur peaks. Samples were transferred from the SEM to the scanning AES systems, specific particles relocated and surface composition and depth profile information obtained using AES and ion bombardment. Finally, electron spectroscopy for chemical analysis (ESCA) was used to obtain sulfur peaks for all the compounds used in the AES calibration, making possible the correlation of information with that obtained with the high spatial resolution scanning Auger system. The overall approach and feasibility studies of the various technical procedures all showed positive results. It is indicated that a combination of techniques can be used successfully for compound identification of individual particles, even for particles in the 1 to 10 micrometer range or smaller.

5258 **(LBL—11677) Graphitic carbon in urban environments and the Arctic.** Rosen, H.; Hansen, A.D.A.; Dod, R.L.; Gundel, L.A.; Novakov, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 38p. (CONF-8010135—2). NTIS, PC A03/MF A01.

From General Motors Research Laboratory conference, particulate carbon: atmospheric life cycle; Warren, MI, USA (12 Oct 1980).

Recent measurements of aerosol particles indicate the presence of a large optically absorbing component which can cause visibility degradation and climatic effects. The nature of this absorbing species has been investigated by a variety of modern methods of analysis, which has led to its identification on a microscopic level as graphitic (black) carbon. In our paper this methodology is described and extended to the quantification of graphitic carbon and its absorption coefficient. New results from the Arctic are also presented, which show the presence of graphitic carbon concentrations comparable to those found in urban environments.

5259 **(PB—80-166994) Chemistry of precipitation from sequentially sampled storms. Final report, Oct 76-Sep 78.** Robertson, J.K.; Dolzine, T.W.; Graham, R.C. (Military Academy, West Point, NY (USA). Science Research Lab.). Jan 1980. 129p. NTIS, PC A07/MF A01.

Sequential sampling techniques and applications to collect precipitation are reviewed. Chemical data for samples collected by an intensity-weighted sequential sampling device in operation at the U.S. Military Academy, West Point, New York from October 1976 to April 1978 are presented and discussed. The problem of dry deposition is explored. A newly designed intensity-weighted sequential sampler that excludes dry deposition is presented. The experiments have shown that intensity-weighted sequential sampling is a viable technique for monitoring the rapid changes in precipitation chemistry within a storm. Complete chemical data are needed from individual storms to evaluate intensity related scavenging.

5260 **(PB—80-167026) Microscopical analysis of aerosols collected in St. Louis, Missouri. Final report, Jun 75-Oct 77.** Draftz, R.G.; Severin, K. (IIT Research Inst., Chicago, IL (USA)). Feb 1980. 61p. NTIS, PC A04/MF A01.

A study of the concentration of total suspended particulates (TSP) was conducted at two sampling sites in St. Louis, Missouri during July 1975. One site located at the southeastern boundary of the city was adjacent to an industrial area. The other sampling site was located in the commercial downtown area of St. Louis. Selected filters were analyzed microscopically to determine the types and sources of particles contributing to the TSP. The principal cause of high TSP concentrations, except for one sample from the industrial site, was the mineral calcite, which accounted for approximately 50% to 80% of the total TSP at both sites. The highest TSP concentration--214.4 microgram/cu m recorded at the site near the industrial area--was the only sample that showed significant contributions from industrial sources. Approximately 60-75% of the TSP was due to coal and coke particles, probably produced for, or used in, metallurgical reduction. Another 5-15% of the TSP was composed of titanium dioxide and hydrated iron oxides, probably from pigment production.

5261 **(PB—80-167042) Carbonaceous aerosol generator for inhalation studies. Final report, Feb 78-Apr 79.** Lee, T.G.K.; Mulholland, G.W. (National Bureau of Standards, Washington, DC (USA)). Feb 1980. 53p. NTIS, PC A04/MF A01.

A carbonaceous aerosol generator designed for inhalation experiments with animals is described. The aerosol produced from a modified diffusion flame has a concentration of 3-10 mg/cu m at a flow rate of 30 L/min. The addition of a small amount of oxygen to the acetylene fuel greatly increased the efficiency of fuel to particulate conversion, the maximum value was 2.5%. The aerosol size characteristics were: Dgn = 0.14 micro m, based on the electrical aerosol analyzer, approximately 0.08 micro m, based on a low pressure inertial impactor; median elementary particle approximately 0.023 micro m and median agglomerate particle approximately 0.54 micro m, based on transmission electron microscopy. The size characteristics of the generated aerosol are compared with diesel exhaust based on available published data.

5262 **(PB—80-167257) Freshwater findings, 1976-1978. Research publications of the Environmental Research Laboratory, Duluth, Minnesota. Bibliography report.** Russom, C. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). Jan 1980. 68p. NTIS, PC A04/MF A01.

This bibliography, inclusive from 1976 through 1978 lists all publications authored by personnel of the Environmental Research Laboratory-Duluth. Some of the research findings were to determine how physical and chemical pollution affects aquatic life; to assess the effects of ecosystems on pollutants; to predict effects of pollutants on large lakes through use of models; to measure bioaccumulation of pollutants in aquatic organisms that are consumed by other animals, including man.

5263 **(PB—80-168065) Approaches to analyzing data from the Portland Study, Task 4. Final report.** Lai, L.S.L.; Gins, J.D. (Technology Service Corp., Santa Monica, CA (USA)). May 1979. Contract EPA-68-03-2392. 181p. NTIS, PC A09/MF A01.

The EPA is currently conducting the Short Test Correlation and Effectiveness Study (Portland Study), a large-scale emission testing program, in Portland, Oregon. For all the vehicles involved in the study, vehicle emissions are measured by three short tests (STs) at a state inspection station and by the three tests plus the Federal Emission Certification Test Procedure (FTP) at an emission testing laboratory. The two basic areas of interest in the Portland Study are: (1) the issue of association of short-test emissions (as measured in areal-world inspection/maintenance environment) and FTP emissions; and (2) theoretical and practical questions concerning the process of inspection and maintenance. The purpose of this report is to provide various sound statistical procedures that could be used in analyzing data from the Portland Study.

5264 **(PB—80-168156) MPTER (Multiple Point Algorithm with Terrain Adjustment). Model-simulation.** Pierce, T.E.; Turner, D.B.; Busse, A.D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). 17 Mar 1980. mag taep. Source tape is in ASCII character set. Character set restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products, if you have questions.

Tape MPTER contains (1) an air quality simulation model, MPTER, and seven example runstreams for the model; (2) two postprocessor programs useful for determining highest and second highest concentrations for air quality simulation model output: TPHI5 for end-to-end averages and TPRN25 for running averages; (3) formatted meteorological data useful for CRSTER, RAMF, and MPTER example runs; (4) a program (UNFORMET) to convert the above meteorological data into unformatted form for entry to the stated models; and (5) a program PTPLU, an improvement of PTMAX, which determines maximum concentrations and distance to maximum concentration for a variety of wind speed and stability conditions. Calculations are made both for wind speed constant with height and wind speed increasing with height. MPTER is useful for estimating relatively non-reactive pollutant concentrations hour-by-hour using the Gaussian steady-state model. The model is most applicable for source-receptor distances less than 10 km in level or gently rolling terrain. Available options include terrain adjustment, gradual plume rise, stack downwash, and buoyancy-induced dispersion.

5265 **(PB—80-168453) Real-time forecasting of air pollution episodes in the venetian region. Part I: the advection - diffusion model. Part II: the Kalman predictor. Final report.** Runca, E.; Melli, P.; Spirito, A.; Fronza, G.; Tonielli, A. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). 1979. 52p. NTIS PC E03/MF E03.

The overall object of this research is to set up a scheme for predicting ground-level pollutant considerations for real time control purposes. The forecasting scheme is described, together with its application to sulfur dioxide pollution in the Venetian lagoon area. The scheme is based on a mathematical model to be run on a computer and receiving at the beginning of each interval of time all the information required for the prediction. The type of control action which should be taken on the basis of such a forecast is the object of this part of the research.

5266 **(PB—80-168982) Smeared concentration approximation method: a simplified air pollution dispersion methodology for regional analysis. Final report.** Dennis, R.L. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). 1978. 77p. NTIS PC E04/MF E04.

This paper describes a simplified method, the smeared concentration approximation (SCA) method, developed to characterize air pollution dispersion on the local scale. The SCA method is intended for use in models and analysis concerned with long term policy analysis at the regional level. The methodology centers around the development of SCA dispersion parameters for short-range transport (urban scale) for each of three emission classes: low-level area sources, medium-level point sources, and high-level point sources. Development of the SCA dispersion parameters, using detailed air pollution dispersion models, is described. An SCA dispersion kit for each of the three emission classes is given. Validation of the SCA method and examples of its use are discussed. Some typical questions concerning the use of the SCA method are also discussed. In an Appendix, an example is worked through to show how the SCA dispersion kits are used to develop each SCA dispersion parameter.

5267 **(PB—80-169063) Health hazard evaluation determination report HE 80-7-661, Jan Clopton Composition, Atlanta, Georgia.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1980. 8p. NTIS, PC A02/MF A01.

NIOSH conducted an environmental evaluation of the Jan Clopton Composition Co., Atlanta, Georgia. Air quality in the typesetting area was checked using direct reading detector tubes. Samples of air discharged from typesetting and photographic equipment were collected on organic vapor adsorbing charcoal tubes and submitted to the NIOSH laboratory for analysis. Measureable quantities of aldehydes, sulfur dioxide, and ozone were not found using detector tubes. Carbon monoxide was detected at a level of 5 parts per million (ppM), which is well below the NIOSH recommended limit of 35 ppM. Laboratory analysis of the air samples collected from typesetting and photographic equipment found trace amounts of 1,1,1-trichloroethane (methyl chloroform) and low molecular-weight aliphatic hydrocarbons (C6 to C10) alkanes. Exposure to these substances at the levels detected were not considered hazardous.

5268 **(PB—80-169238) Preparation of standards for valence state measurement by x-ray fluorescence. Final report.** Peters, E.T.; Menzies, K.T. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jan 1980. Contract EPA-68-02-2750. 43p. NTIS, PC A03/MF A01.

The preparation and characterization of standard samples representing several valence states for sulfur, vanadium, and chromium are described. The standards will be used by the U.S. Environmental Protection Agency to investigate the potential for determining valence state by high resolution wavelength dispersive x-ray emission analysis. A total of 40 single state and 13 multistate standards were prepared by dust generation and collection on polycarbonate filters. The prepared samples and valence states include sulfur (0, +4, +6, -2), vanadium (0, +4, +5), and chromium (+3, +6). At least three standards were prepared for each valence state, with mass concentration of the valence state element in the range 1 to 50 micrograms/sq cm. The prepared samples were coated with a thin layer of nitrocellulose by a wicking procedure to provide a protective coating and to prevent loss of material. Representative samples were analyzed for the uniformity of the deposit, mean particle size and stability in air, and x-ray irradiation.

5269 **(PB—80-169436) Scheme for estimating dispersion parameters as a function of release height. Report for Jul 77-Jun 79.** Irwin, J.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Oct 1979. 68p. NTIS, PC A04/MF A01.

A generalized scheme is presented for estimating atmospheric pollutant dispersion parameters as a function of release height. Further development is needed to refine the scheme for more generalized applicability, since, as documented in this discussion, the scheme requires as input meteorological data not routinely available. The scheme incorporates results from various studies, and once it is more practically structured it will prove useful for characterizing dispersion from tall sources in a variety of situations. The generalized scheme was developed particularly for Gaussian plume modeling; therefore, it is restricted to modeling applications having flat terrain and having steady-state meteorological conditions.

5270 **(PB—80-169550) Investigation of NO_2/NOx ratios in point source plumes. Final report, Dec 78-Dec 79.** Blanks, J.P.; Hamilton, E.P. III; Eppright, B.R.; Nielsen, N.A. (Radian Corp., Austin, TX (USA)). Feb 1980. Contract EPA-68-02-2608. 74p. NTIS, PC A04/MF A01.

The report gives results of a study to relate ground level NO_2 concentrations to NOx emissions (NO_2/NOx ratio) in plumes

from six large power plants in the Chicago area, using a photostationary state reactive Gaussian plume model. The aim of the study was to assess the level of NOx control required to meet a probable short-term NO2 national ambient air quality standard (NAAQS). The major uncertainty of an earlier study was its assumption of uniform, fixed NO2/NOx ratios of 0.5 (summer) and 0.25 (winter). The previous study indicated that most of the six plants could meet a 500 microgram/cu m short-term NO2 standard using NOx combustion modification techniques (50% NOx control); this study indicates NOx flue gas treatment technology (90% control) may be required on these plants to meet a 750 microgram/cu m standard, and most certainly for 500 micrograms/cu m.

5271 **(PB—80-169576) Dispersion of sulfur dioxide from the Clinch River Power Plant, a wind-tunnel study. Fluid modeling Report No. 7, Jun 77-Dec 78.** Thompson, R.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Sep 1979. 75p. NTIS, PC A04/MF A01.

A wind-tunnel study of the transport and dispersion of sulfur dioxide from the Clinch River Power Plant in Virginia was performed for periods of neutral atmospheric conditions corresponding to two 1-hour periods for which field data were available. A 7-km x 21-km area of the quite rugged complex terrain surrounding the power plant was modeled at a scale of 1:1920 using a terraced construction. Exaggerated stack diameters were used in modeling the buoyant emissions from the plant's two stacks.

5272 **(PB—80-169675) Computer modeling of simulated photochemical smog. Final report, Sep 77-Aug 79.** Hendry, D.G.; Baldwin, A.C.; Golden, D.M. (SRI International, Menlo Park, CA (USA)). Feb 1980. Contract EPA-68-02-2427. 222p. NTIS, PC A10/MF A01.

Efforts to develop chemical kinetic mechanisms to describe the formation of photochemical smog are discussed. Detailed mechanisms for the atmospheric reactions of toluene, m-xylene, propene, ethene, formaldehyde and acetaldehyde were constructed from available experimental and chemical kinetic data. These mechanisms were used to simulate smog chamber data from the Statewide Air Pollution Research Center at the University of California, Riverside and the outdoor facility of the University of North Carolina.

5273 **(PB—80-169691) Regional air pollution study: gas chromatography laboratory operation. Final report.** Cardwell, G. (Rockwell International Corp., Creve Coeur, MO (USA). Environmental Monitoring and Services Center). Jan 1980. Contract EPA-68-02-2093. 139p. NTIS, PC A07/MF A01.

A gas chromatography laboratory was set up to analyze air samples collected in Teflon bags and stainless steel tanks. Samples were analyzed for total hydrocarbons, methane, CO, and C2-C10 hydrocarbons. A total of 455 samples, including replicates, were analyzed during the summer and fall of 1976. Many samples were collected at 12 of the Regional Air Monitoring Systems (RAMS) sites to yield data on spatial and temporal distributions of hydrocarbons. Additional sampling was performed to study ethylene contamination in and around RAMS stations. Roadway samples were collected to determine the composition of freshly emitted vehicular pollution. Quality control audits indicated good system performance during the study. Replicate samples indicated good reproducibility for samples stored for as long as six days in the Teflon bags. All data, including sums of paraffins, olefins, aromatic, and total non-methane hydrocarbons are stored in the RAPS Data Bank at Research Triangle Park, North Carolina.

5274 **(PB—80-170178) MULTIMAX: an air dispersion modeling program for multiple sources, receptors, and concentration averages. Final report.** Moser, J.H. (Shell Development Co., Houston, TX (USA)). Aug 1979. 197p. NTIS, PC A09/MF A01.

Since this manual was originally published in December of 1977, a number of developments have taken place which warrant a complete update. The original computer program was developed on a Univac 1110 computer; a number of machine-dependent features of the software were utilized in order to attain maximum flexibility of the program from a user's standpoint. In 1978, the Tennessee Valley Authority modified the Univac 1110 version of MULTIMAX so that it would run on IBM 360/370 computers. The major additions to this User's Manual are Appendices which discuss input formats for the IBM program version, certain machine-dependent features of the programs and show example inputs and outputs for the Univac and the IBM versions.

5275 **(PB—80-174360) APTI course 450: source sampling for particulate pollutants - student manual.** Aldna, G.J.; Jahnke, J.A. (Northrop Services, Inc., Research Triangle Park, NC (USA)). Dec 1979. Contract EPA-68-02-2374. 202p. NTIS, PC A10/MF A01.

This manual is used in conjunction with Course No. 450, 'Source Sampling for Particulate Pollutants', as designed and presented by the EPA Air Pollution Training Institute (APTI). The manual supplements the course lecture material, presenting detailed discussions in an introductory manner on the following topics: Basic Definitions for Source Sampling; Basic Concepts of Gases; The EPA Method 5 Sampling Train; The EPA Method 5 Source Test; Calibration Procedures; Source Sampling Calculations; Report Writing; Error Analysis; F-factor Methods; Particle Sizing; and Opacity Monitoring. Derivations are given for many of the basic source sampling equations. The manual, when used with the student workbook, EPA-450/2-79-007, during the lecture and laboratory sessions of Course No. 450, provides comprehensive instruction in the performance of EPA reference method 5.

5276 **(PB—80-174964) Summary report of the NCAQ Atmospheric Dispersion Modeling Panel. Volume 1: recommendations. Final report.** Chandler, M.W.; Lewis, J.; Zalcman, B.; Kelly, J.I.; Nugent, A.E. (Dames and Moore, Bethesda, MD (USA)). Mar 1980. Contract 5-AQ-7379. 87p. NTIS, PC A05/MF A01.

This is volume 1 of a two-volume report of an Atmospheric Dispersion Modeling Panel convened by the National Commission on Air Quality to provide guidance on: (1) uses and limitations of currently available models for air quality management and (2) appropriate dispersion models and/or technical approaches to be considered in the Commission's evaluation of the Clean Air Act through five comprehensive regional studies (Los Angeles area, Four Corners area, Minneapolis/St. Paul, New York/Hartford, and the Ohio River Valley from Louisville to Cincinnati). Volume 1 contains Panel statements and recommendations and summaries of Panel deliberations.

5277 **(PB—80-175250) Carbon dioxide and climate: a scientific assessment.** (National Research Council, Washington, DC (USA). Climate Research Board). Jul 1979. 35p. NTIS, PC A03/MF A01.

Atmospheric concentrations of carbon dioxide are steadily increasing, and these changes are linked with man's use of fossil fuels and exploitation of the land. Since carbon dioxide plays a significant role in the heat budget of the atmosphere, it is reasonable to suppose that continued increases would affect climate. These concerns have prompted a number of investigations of the implications of increasing carbon dioxide. Their consensus has been that increasing carbon dioxide will lead to a warmer earth with a different distribution of climatic regimes. In view of the implications of this issue for national and international policy planning, the Office of Science and Technology Policy requested the National Academy of Sciences to undertake an independent critical assessment of the scientific basis of these studies and the degree of certainty that could be attached to their results.

5278 **(PNL—3612) MAP3S/RAINE precipitation chemistry network: quality control.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1980. Contract AC06-76RL01830. 76p. NTIS, PC A05/MF A01.

The participants of the precipitation chemistry network of the Multi-State Atmospheric Power Production Pollution Study/ Regional Acidity of Industrial Emissions (MAP3S/RAINE) have developed procedures for maintenance of high quality output from the network operation. The documented procedures-most of which were in place before the network began sampling in 1976-include those for site selection and verification, field equipment, laboratory and data handling, and external laboratory quality testing.

5279 **(PNL-SA—8986) Interfacing air pathway models with other media models for impact assessment.** Drake, R.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1980. Contract AC06-76RL01830. 20p. (CONF-801039—4). NTIS, PC A02/MF A01.

From 20. annual Hanford Life Sciences symposium; Richland, WA, USA (19 Oct 1980).

The assessment of the impacts/effects of a coal conversion industry on human health, ecological systems, property and aesthetics requires knowledge about effluent and fugitive emissions, dispersion of pollutants in abiotic media, chemical and physical transformations of pollutants during transport, and pollutant fate passing through biotic pathways. Some of the environmental impacts that result from coal conversion facility effluents are subtle, acute, subacute or chronic effects in humans and other ecosystem members, acute or chronic damage of materials and property, odors, impaired atmospheric visibility, and impacts on local, regional and global weather and climate. This great variety of impacts and effects places great demands on the abiotic and biotic numerical simulators (modelers) in terms of time and space scales, transformation rates, and system structure. This paper primarily addresses the demands placed on the atmospheric analyst. The paper considers the important air pathway processes, the interfacing of air pathway models with other media models, and the classes of air pathway models currently available. In addition, a strong plea is made for interaction and communication between all modeling groups to promote efficient construction of intermedia models that truly interface across pathway boundaries.

5280 **Environmental and health aspects of biomass energy systems.** Braunstein, H.M; Kornegay, F.C. (Oak Ridge National Lab., TN). Contract W-7405-ENG 26. *USAmerican Chemical Society, Division of Fuel Chemistry, Preprints (U.S.);* **25**: No. 4, 337-342(1980). (CONF-800814—P3).

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

The environmental and health aspects of residential wood combustion are discussed. Potential impacts of biomass production are: land use; water use; erosion and sedimentation; agricultural and forest runoff; disturbance of ecosystems; air quality; water quality; and institutional and social impacts. Maximum one-hour ground level concentrations of emission from one wood-burning device are tabulated. (DMC)

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 4577, 4585, 4885, 5294, 5431, 5441

5281 **(BNL—51252) 1979 environmental monitoring report.** Naidu, J.R. (ed.). (Brookhaven National Lab., Upton, NY (USA)). Apr 1980. Contract AC02-76CH00016. 100p. NTIS, PC A05/MF A01.

The environmental levels of radioactivity and other pollutants found in the vicinity of Brookhaven National Laboratory (BNL) during 1979 are summarized. As an aid in the interpretation of the data, the amounts of radioactivity and other pollutants released in airborne and liquid effluents from Laboratory facilities to the environment are also indicated. The environmental data includes external radiation levels; radioactive air particulates; tritium and iodine concentrations; the amounts and concentrations of radioactivity in and the water quality of the stream into which liquid effluents are released; the concentrations of radioactivity in sediments and biota from the stream; the concentrations of radioactivity in and the water quality of ground waters underlying the Laboratory; and concentrations of radioactivity in milk samples obtained in the vicinity of the Laboratory.

5282 **(CONF-801038—17) Comparison of HEPA filter test methods in corrosive environments.** Murphy, L.P.; Fernandez, S.J.; Motes, B.G. (Idaho Chemical Corp., Idaho Falls (USA); Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA); Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-79ID01675. 22p. NTIS, PC A02/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The in-plant testing of process off-gas high efficiency particular air (HEPA) filters is an important quality control activity of the ALARA (As Low As Reasonably Achievable) policy at nuclear facilities. Imprecise and irreproducible data were recorded during DOP testing at the Atmospheric Protection System (APS) of the Idaho Chemical Processing Plant (ICPP). The tests at the APS are performed in an environment that has high humidity, high temperatures and has NO/sub x/ present. An evaluation of three HEPA filter test methods in corrosive environments was conducted: the dioctyl phthalate (DOP) method (US Standard Method ANSI N-101.1-1979) the sodium chloride method (British Standard 3928:1969), and the soda-fluorescein or uranine method (French Standard AFNOR STD NFX 44-011). The effects of high humidity, temperature, and oxides of nitrogen (NO/sub x/) on each method was examined. The effects of each variable and any interaction between variables on the test methods were examined. Recommendations for changes in the standard methods to reduce erratic on-line results are presented.

5005 Site Resource And Use Studies

5283 **(ANL/EES-TM—110) Baseline air quality study at Fermilab.** Dave, M.J.; Charboneau, R. (Argonne National Lab., IL (USA)). Oct 1980. Contract W-31-109-ENG-38. 114p. NTIS, PC A06/MF A01.

Air quality and meteorological data collected at Fermi National Accelerator Laboratory are presented. The data represent baseline values for the pre-construction phase of a proposed coal-gasification test facility. Air quality data were characterized through continuous monitoring of gaseous pollutants, collection of meteorological data, data acquisition and reduction, and collection and analysis of discrete atmospheric samples. Seven air quality parameters were monitored and recorded on a continuous real-time basis: sulfur dioxide, ozone, total hydrocarbons, nonreactive hydrocarbons, nitric oxide, nitrogen oxides, and carbon monoxide. A 20.9-m tower was erected near Argonne's mobile air monitoring laboratory, which was located immediately downwind of the proposed facility. The tower was instrumented at three levels to collect continuous meteorological data. Wind speed was monitored at three levels; wind direction, horizontal and vertical, at the top level; ambient temperature at the top level; and differential temperature between all three levels. All continuously-monitored parameters were digitized and recorded on magnetic tape. Appropriate software was prepared to reduce the data. Statistical summaries, grphical displays, and correlation studies also are presented.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

5284 **(BNL—51129) ESUSA: US endangered species distribution file.** Nagy, J.; Calef, C.E. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract AC02-76CH00016. 71p. NTIS, PC A04/MF A01.

This report describes a file containing distribution data on endangered species of the United States of Federal concern pursuant to the Endangered Species Act of 1973. Included for each species are (a) the common name, (b) the scientific name, (c) the family, (d) the group (mammal, bird, etc.), (e) Fish and Wildlife Service (FWS) listing and recovery priorities, (f) the Federal legal status, (g) the geographic distribution by counties or islands, (h) Federal Register citations and (i) the sources of the information on distribution of the species. Status types are endangered, threatened, proposed, formally under review, candidate, deleted, and rejected. Distribution is by Federal Information Processing Standard (FIPS) county code and is of four types: designated critical habitat, present range, potential range, and historic range.

5285 **(DOE/ER/01338—1) Plant research '79: report of the Michigan State University, Department of Energy, Plant Research Laboratory.** (Michigan State Univ., East Lansing (USA). MSU/AEC Plant Research Lab.). 1979. Contract AC02-76ER01338. 176p. NTIS, PC A09/MF A01.

Botanical research conducted at MSU during 1979 is described. Areas of study include cell wall biosynthesis, hormonal regulation, responses of plants to environmental stresses, and molecular studies. (ACR)

5286 **(DOE/ET/27107—T1) Peregrine Falcon study. Final report.** (GRIPS Commission, Santa Rosa, CA (USA)). 1 Feb 1980. Contract FG03-78ET27170. 169p. NTIS, PC A08/MF A01.

Separate abstracts were prepared for the three included papers. (MHR)

5287 (DOE/ET/27107—T1, pp 54p, Paper 1) **Peregrine Falcons of Mount Saint Helena in the Geysers-Calistoga Known Geothermal Resource Area. Phase I field study.** Kirven, M.N. (Sonoma State Univ., Rohnert Park, CA). 1 Feb 1980.

In Peregrine Falcon study. Final report.

The Phase I field study was conducted from 30 May to 20 August 1978 in an effort to monitor the foraging and breeding activities of a family of endangered American Peregrine Falcons nesting in the vicinity of Mt. St. Helena, Sonoma County, California to determine, if possible, the extent to which these birds utilize the adjacent Known Geothermal Resource Area. Prominent local terrain features and forest vegetation hampered visual tracking of the falcons throughout the durations of their foraging flights and 59.6% of all observed flights and 93.3% of all successful flights were lost from view of the observers at the terminal extensions. In spite of this inherent difficulty 65 map plots were recorded for foraging flights within a 3.3 kilometer radius of the nesting site and two major flight corridors were identified along which 68% of all flights were oriented. The mean duration of successful flights of the adult male was 68.3 minutes, which was substantially shorter than observed for peregrines nesting at the nearby Palisades eyrie in Napa County suggesting the possible superiority of the Mt. St. Helena foraging habitat. From prey remains found in the vicinity of the nesting site thirteen species were identified. Pigeons and doves comprised 67.3% of the total biomass, compared to 69.4% at the Palisades eyrie in 1975, stressing the importance of these birds as prey items.

5288 (DOE/ET/27107—T1, pp 24p, Paper 2) **Preliminary study of the Peregrine Falcons in the proposed geothermal development area, Sonoma County, California. Phase I Appendix A.** Kirven, M.N. (Sonoma State Univ., Rohnert Park, CA). 1 Feb 1980.

In Peregrine Falcon study. Final report.

In the summer of 1977, a field study was undertaken to monitor the foraging activities of a family of American Peregrine Falcons nesting in the vicinity of the Republic Geothermal-McMicking Leasehold, Sonoma County, California, in an effort to determine the relative importance of the Briggs Creek drainage habitat within the Leasehold. Observational data consisting of visual compass bearings and triangulations of flight patterns of the falcons, and nest site activities, were interpreted to suggest that approximately one-third of the foraging flights were in the direction of the Briggs Creek drainage. Transect bird population censuses taken by Leitner and Miller in the riparian habitat were compared to prey remains collected at the falcon eyrie and showed a 23% overlap. Firm conclusions on the relative importance of the Briggs Creek habitat to the falcons during the critical reproductive period could not be drawn because the data were not sufficiently comprehensive. It was suggested that a more thorough study utilizing established techniques of radio-telemetry be initiated as soon as possible so that more definitive statements can be made about the importance of the Briggs Creek habitat and the potential impact of geothermal development to the survival of the Peregrine Falcons.

5289 (DOE/ET/27107—T1, pp 31p, Paper 3) **Peregrine Falcon foraging study in the Geysers-Calistoga Known Geothermal Resource Area, Sonoma County, California, 1979. Phase II final report.** Enderson, J.H. (Colorado Coll., Colorado Springs); Kirven, M.N. 1 Feb 1980.

In Peregrine Falcon study. Final report.

Two adults and two young peregrine falcons were radiotagged to determine foraging behavior near an eyrie in the Geysers-Calistoga Known Geothermal Resource Area. Equipment failure prevented detailed analysis of movements, but tracking data coupled with data from observers near the eyrie permitted analysis of 139 flights by the female and 40 by the male. Flights were categorized as those less than 1 km from the eyrie, extending about 1 km but perhaps proceeding farther, and long flights beyond 1 km. All flights were assigned one of seven vectors, one of which was in the direction of the geothermal area. Long flights on that vector included 9 and 12% of all long flights for the female and male respectively. Long flights for the female were mainly southeast from the eyrie (36%) and for the male they were southwest (35%). The observer data alone in 1979 indicated that 11% and 15% of the flights of the female and male, respectively, were toward the geothermal area. Inbound flights by both sexes with prey from the geothermal area included 17% of all such flights. About 12% of flights made by both sexes observed in another study in 1978 were to or from the development area, and other 1977 results suggest that up to 33% were in that direction. The proposed development site is small and lies 6 km west of the eyrie. The relatively few flights in that direction, the non-selective use by the falcons of flight routes in most other directions, and the general high abundance of prey in the region indicate that development of the geothermal site would not result in significant loss of foraging resource to the peregrines.

5290 **Energy flow, nutrient cycling, and ecosystem resilience.** DeAngelis, D.L. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *USEcology (U.S.);* **61**: No. 4, 764-771(Aug 1980).

The resilience, defined here as the speed with which a system returns to equilibrium state following a perturbation, is investigated for both food web energy models and nutrient cycling models. Previous simulation studies of food web energy models have shown that resilience increases as the flux of energy through the food web per unit amount of energy in the steady state web increases. Studies of nutrient cycling models have shown that resilience increases as the mean number of cycles that nutrient (or other mineral) atoms make before leaving the system decreases. In the present study these conclusions are verified analytically for general ecosystem models. The behavior of resilience in food web energy models and nutrient cycling models is a reflection of the time that a given unit, whether of energy or matter, spends in the steady state system. The shorter this residence time is, the more resilient the system is.

5291 **Energy and nitrogen relations for a Macrosiphum liriodendri (Homoptera:Aphididae) population in an east Tennessee Liriodendron tulipifera stand.** Van Hook, R.I.; Nielsen, M.G.; Shugart, H.H. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *USEcology (U.S.);* **61**: No. 4, 960-975(Aug 1980).

Biomass and density of all instars of a Liriodendron aphid population on three mature trees in an east Tennessee yellow poplar stand were determined for the 1971 growing season. Concurrently, laboratory studies were caried out to ascertain rates of each aphid instar's metabolism, growth, reproduction, and honeydew production. Similarly, whole body caloric content and concentrations of N were determined for each instar. Results from these studies were utilized in estimating ingestion of sap by the aphid population, and in developing a mathematical model of aphid population dynamics. These estimates were used in preparing annual budgets of dry matter, energy, and N for the population.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 4587, 4595, 4595, 4597, 5324

5292 (DOE/DP/00269—39) Amchitka Radiobiological Program progress report, January 1979-December 1979. Thornberg, L.D.; Sibley, T.H.; Nakatani, R.E. (Washington Univ., Seattle (USA). Coll. of Fisheries). Jul 1980. Contract AS08-76DP00269. 67p. NTIS, PC A04/MF A01.

The objective of the Amchitka Radiobiological Program for the period 1970-1979 was to determine the extent of radionuclide contamination from world-wide atmospheric fallout and from the detonation of three underground nuclear blasts on Amchitka Island. The objective is achieved, by the collection and radiological analyses of biological and environmental samples and by background radiation measurements. Leakage of radionuclides from the underground sites of the Amchitka nuclear detonations would be suspected if the contamination was signifincntly greater than would be expected from world fallout. An account of the program from July 1970 to December 1978 has been given in nine previous reports from the Laboratory of Radiation Ecology to the Nevada Operations Office of the US Department of Energy. This report is an account of the program for calendar year 1979. The results of analyses of the samples collected in 1979 lead to the same conclusions as in previous years; i.e., there is no evidence that the radionuclide contamination at Amchitka Island is greater than would be expected from world fallout except for a slight contamination of the Long Shot Mud Pits with tritium.

5293 (EGG—1183-1772) Aerial radiological survey of the Nuclear Engineering Company (NECO) facility and surrounding area, Sheffield, Illinois. (EG and G, Inc., Santa Barbara, CA (USA). Energy Measurements Group). Sep 1979. Contract AC08-76NV01183. 9p. NTIS, PC A02/MF A01.

An aerial radiological survey to measure terrestrial gamma radiation was carried out over the Nuclear Engineering Company (NECO) facility located near Sheffield, Illinois. Gamma ray data were collected over a 13 km^2 area enclosing the facility by flying north-south lines spaced 91 m apart. Processed data indicated that detected radioisotopes and their associated gamma ray exposure rates were consistent with those expected from normal background emitters. Estimated exposure rates 1 m above the ground, as calculated from the aerial data, are presented in the form of an isopleth map. No ground sample data were taken at the time of the aerial survey.

5294 (LA—8559-PR) Environmental and radiological safety studies: interaction of $^{238}PuO_2$ heat sources with terrestrial and aquatic environments. Progress report, April 1-June 30, 1980. Waterbury, G.R. (comp.). (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 44p. NTIS, PC A03/MF A01.

The containers for $^{238}PuO_2$ heat sources in radioisotope thermoelectric generators are designed with large safety factors to ensure that they will withstand reentry from orbit and impact with the earth and safely contain the nuclear fuel until it is recovered. Existing designs have proved more than adequately safe, but the Office of the Assistant Director for Safety and Reliability of the Department of Energy Division of Advanced Systems and Materials Production continually seeks more information about the heat sources to improve their safety. The work discussed here includes studies of the effects on the heat source of terrestrial and aquatic environments to obtain data for design of even safer systems. The data obtained in several ongoing experiments are presented; these data tables will be updated quarterly. Discussions of experimental details are minimized and largely repetitive in succeeding reports. Compilations of usable data generated in each experiment are emphasized. These compilations include data from environmental chamber experiments that simulate terrestrial conditions, experiments to measure PuO_2 dissolution rates, soil column experiments to measure sorption of plutonium by soils, and several aquatic experiments.

5295 (RFP—3118) Soil decontamination study, DOE facilities. Hayden, J.A.; Arnold, P.M.; Stevens, J.R.; Kochen, R.L.; Gallagher, K.Y.; Rutherford, D.W.; Damkroger, B.K. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1980. Contract AC04-76DP03533. 49p. (CONF-800753—2). NTIS, PC A03/MF A01.

From US DOE transuranic waste management program decontamination technology transfer meeting; Richalnd, WA, USA (29 Jul 1980).

Research activities related to soil decontamination at Rocky Flats are summarized. The prospect of using soil decontamination methods for decontaminating transuranic (TRU) wastes is good. The approach is to remove the activity by attrition scrubbing followed by dispersion. Significant similarities and differences among soils from 5 DOE sites are discussed. Current guidelines for contaminated soils (actinides) are listed. Criteria for the disposition soil generated in the decontamination process are given. Several decontamination tests are described. (DMC)

5296 Comparison of the distribution of industrially released ^{238}Pu and fallout /sup 239,240/Pu in temperate, northern United States soils. Alberts, J.J.; Bobula, C.M. III; Farrar, D.T. *USJournal of Environmental Quality (U.S.);* **9**: No. 4, 592-596(1980).

Studies of ^{238}Pu dispersed from the stack of nuclear fabrication facility in southwestern Ohio indicate that the predominant deposition occurs with 8 km of the site. Plutonium-238 from this source exhibits the same relative solubility as /sup 239,240/Pu from fallout. Both ^{238}Pu from the facility and /sup 239,240/Pu from fallout move downward through the soil column, but ^{238}Pu appears to have moved more slowly. Reasons for this apparent differential behavior are explored.

5297 (ORNL-tr—4695) Investigation of the behavior of radionuclides in the ground. Nishimaki, K. (Oak Ridge National Lab., TN (USA)). Oct 1978. Translation of a Japanese paper. 29p. NTIS, PC A03/MF A01.

Thesis.

Research was conducted with the aim of establishing a basis for safety assessments for the disposal of radioactive waste; this research consisted of experimental investigations on the behavior of radionuclides that enter the groundwater when radioactive materials escape into the ground from a radioactive waste disposal facility located at the site of a nuclear power plant. The present report was drawn primarily from the results of field tests comprising one segment of this research. Actual field tests were conducted at the proposed land storage site for a nuclear power plant in Japan, and the movement of groundwater examined, on the basis of which the behavior of radionuclides in the ground was derived. To study the behavior of water, a group of observation wells were located in a concentric arrangement, sample water to which NaBr had been added as a tracer (hereafter shortened to test water) poured [into the ground] at the center point, and the Br concentration in the groundwater subsequently collected from the observation wells measured. In the laboratory the distribution coefficients of radioactive cations (^{60}Co and ^{85}Sr) to the sand, which governs the movement of radioactive cations, were obtained experimentally with imitated groundwater. Finally, based on the results of ground water movement obtained in the field tests and the radionuclide distribution coefficients obtained from the laboratory experiments, conjectures are drawn regarding the pattern of radionuclide migration through the ground when water containing those radionuclides permeates from a given point in A block.

5298 Migration of radionuclides in geologic media--laboratory and field studies. Wolfsberg, K.; Daniels, W.R.; Hoffman, D.C.; Erdal, B.R. (Los Alamos Sci Lab, NM). *USAmerican Society for Testing and Materials, Special Technical Publication (U.S.);* 252-254(1978).

Experimental results obtained from investigation of the radionuclide distribution in the environment around the 0.75-kiloton nuclear test Cambric, fired in alluvium at the Nevada Test Site, are presented and discussed. Laboratory measurements of distribution ratios for sorption-desorption between alluvium and ground-water and leaching rates from test debris are also presented and compared with field data.

5105 Site Resource And Use Studies

5299 **(ANL/LRP-TM—19) Land-use planning for phosphate mining and resource areas: the central Florida case. A workshop synopsis.** LaFevers, J.R.; Toner, W.J.; Guernsey, J.L.; Rifkin, E. (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 48p. NTIS, PC A03/MF A01.

On July 19-20, 1978, a workshop was conducted in Bartow, Florida, on the topic of land-use and reclamation planning in the local phosphate mining region. More than 100 participants attended the workshop representing the phosphate mining industry, environmental groups, research organizations, planning agencies, news media, and governmental regulatory agencies. Various aspects of the environmental and land-use impacts of phosphate mining, together with the state-of-the-art of mitigating adverse impacts, were discussed. The participants were required to work cooperatively to develop a series of alternative land-use plans for a selected mining site that was the focus of a half-day field trip. Overall, the participants developed a number of rational land-use and reclamation plans for the site that were considered acceptable by the majority of the group. There was general agreement that the most valuable aspect of the workshop was the opportunity for individuals with such diverse interests to work cooperatively on a common problem and develop acceptable solutions.

5300 **(USGS-OFR—80-942) Geology of the Syncline Ridge area related to nuclear waste disposal, Nevada Test Site, Nye County, Nevada.** Hoover, D.L.; Morrison, J.N. (Geological Survey, Denver, CO (USA); Fenix and Scisson, Inc., Mercury, NV (USA)). 1980. Contract AI08-78ET44802. 88p. NTIS, PC A05/MF A01.

The Syncline Ridge area is in the western part of Yucca Flat, Nye Co., Nev. Drill holes, geophysical surveys, mapping, and laboratory studies during 1976 through 1978 were used to investigate argillite in unit J (Mississippian) of the Eleana Formation (Devonian and Mississippian) as a possible nuclear waste repository site. Argillite in unit J has a minimum stratigraphic thickness of at least 700 m. The argillite underlies most of the Syncline Ridge area east of the Eleana Range, and is overlain by Quaternary alluvium and the Tippipah Limestone of Syncline Ridge. At the edges of the Syncline Ridge area, alluvium and volcanic rocks overlie the argillite. The argillite is underlain by more than 1000 m of quartzite, siliceous argillite, and minor limestone in older units of the Eleana Formation. These older units crop out in the Eleana Range. The area is divided into southern, central, and northern structural blocks by two lateral faults. The southern and central blocks either have volumes of argillite too small for a repository site, or have irregular-shaped volumes caused by Mesozoic high-angle faults that make the structure too complex for a repository site. The northern block appears to contain thick argillite within an area of 6 to 8 km^2. The postvolcanic history of the Syncline Ridge area indicates that the area has undergone less deformation than other areas in Yucca Flat. Most of the late Tertiary and Quaternary deformation consisted of uplift and eastward tilting in the Syncline Ridge area. Preliminary engineering geology investigations indicate that although the competency of the argillite is low, the argillite may be feasible for construction of a nuclear waste disposal facility. Physical, thermal, chemical, and mineralogical properties of the argillite appear to be within acceptable limits for a nuclear waste repository.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 4678, 5284, 5310, 5492, 5493, 5629

5301 **(ED—174239) Distribution and availability of state and areawide water quality reports in Oklahoma libraries.** McClure, C.R.; Million, A. (Oklahoma Univ., Norman (USA). School of Library Science). 1979. 27p. Available from ERIC Document Reproduction Service (Computer Microfilm International Corporation), Arlington, VA. 22210.

This report examines the distribution and availability of water quality reports in the state of Oklahoma. Based on legislation from the Clean Water Act and regulations from the Environmental Protection Agency's 'Public Participation Handbook for Water Quality Management,' depository libraries must be established to provide citizen access to various water quality reports. Results from a survey questionnaire investigating the effectiveness of the depositories in Oklahoma suggest that the depository system has been ineffective in accomplishing its mandated responsibilities. Appendices include a list of agencies and depository libraries, tabulated responses of the survey of depository libraries receiving water quality materials from the three agencies designated by the governor of Oklahoma, and sources for additional information.

5302 **(EGG—2054) Raptor ecology of Raft River Valley, Idaho.** Thurow, T.L.; White, C.M.; Howard, R.P.; Sullivan, J.F. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1980. Contract AC07-76ID01570. 52p. NTIS, PC A04/MF A01.

Raptor data were gathered in the 988-km^2 Raft River Valley in southcentral Idaho while conducting a tolerance study on the nesting Ferruginous Hawk (Buteo regalis) near the Department of Energy's Raft River Geothermal Site. Prior research from 1972 to 1977 on the nesting activity of the Ferruginous Hawk population provided a historical information base. These data are combined with new Ferruginous Hawk data collected between 1978 and 1980 to give a continuous 9-year breeding survey. Information on the distribution, density, and production of the other raptor species found in the study area during 1978 and 1979 is also provided.

5303 **Tolerance and buoyancy of aquatic insect larvae exposed to gas supersaturated water.** Montgomery, J.C.; Fickeisen, D.H. (Battelle Pacific Northwest Labs., Richland, WA). Contract EY-76-C-06-1830. *USEnvironmental Entomology (U.S.);* **8**: No. 4, 655-657(Aug 1979).

Larvae of nonbiting midgeflies, mayflies and caddisflies, and stonefly nymphs were highly tolerant to dissolved gas supersaturation in laboratory bioassays. However, most larvae and nymphs lost some buoyancy control and floated, which could indirectly cause death. The immature insects tested became buoyant when exposed to water containing large quantities of fine air bubbles, simulating conditions that occur in a stilling basin below a dam.

5304 **(PB—80-168941) Coordination of overlapping hierarchical water resources systems. Doctoral thesis.** Sung, K. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Systems Engineering). 10 Jan 1978. 321p. NTIS, PC A14/MF A01.

A multiobjective total system model approach to water resources planning was developed by combining three approaches to planning: The Surrogate Worth Tradeoff (SWT) method, the TECHCOM approach, and the Utility Analysis approach. The SWT method, a quantitative approach, optimizes a mathematical analytical model by mathematical programming and interacts with decision makers. TECHCOM, a scenario approach, displays and analyzes information to reach the best solution for a large-scale complex system. Utility Analysis, a qualitative approach, interacts directly with decision makers to find preferences for different objectives. Using this optimization structure many submodels are developed such as agricultural models, recreational development models, wildlife preservation models, and flooding control models. These models are used in an application of the SWT method to the Maumee River Basin Level-B Study.

5305 **(PB—80-170129) Analysis of patuxent estuarine currents in the vicinity of the Chalk Point Steam Electric Station. Final report.** Polgar, T.T.; Ross, R.N.; Lacey, G.K. (Martin Marietta Corp., Baltimore, MD (USA). Environmental Center). Mar 1980. 83p. NTIS, PC A05/MF A01.

The tidal and nontidal flows in the Patuxent River, between Trueman Point and Benedict Bridge, are described, using time series analysis methods on continuously recording current meter data. The measurements were made in July and August 1978; the entire study area falls within the mesohaline region of the estuary. The results of the analyses indicate that currents in the study area are driven predominantly by semi-diurnal tidal forcing and by wind patterns. Freshwater input into the estuary accounts for the mainte-

nance of vertical density gradients and shears, but it plays a relatively minor role in the estuarine transport processes.

5306 **Application of a digital model for evaluating the bedrock water resources of the Maumee River Basin, northwestern Ohio.** Naymik, T.G. *USGround Water (U. S.);* **17**: No. 5, 438-445(Sep 1979).

Increasing population and industrial development in northwestern Ohio indicated the need for an evaluation of the bedrock ground-water resources of the region. A digital ground-water model was designed and used as a tool for predicting water-level declines resulting from projected ground-water withdrawal. Potentiometric surfaces, keyed to historic, accelerated, and peak projected ground-water withdrawals, were predicted by decades to the year 2036. These withdrawals at the calculated rates will cause severe overdrafts at Lima, Toledo, and Findlay, Ohio, and at Ft. Wayne, Indiana, by the year 2036.

5307 **Influences of diet on the life histories of aquatic insects.** Anderson, N.H.; Cummins, K.W. (Oregon State Univ., Corvallis). *CAJournal of the Fisheries Research Board of Canada (Canada);* **36**: No. 3, 335-342(1979).

From 26. annual meeting of the American Benthological Society, plenary session; Winnipeg, Manitoba, Canada (10 May 1978).

Benthic species are partitioned into functional feeding groups based on food-acquiring mechanisms. Effects of food quality on voltinism, growth rate, and size at maturity are demonstrated for representatives of gougers and shredders, collectors, and scrapers. Food quality for predators is uniformly high, but food quantity (prey density) obviously influences their life histories. A food switch from herbivory to predation, or some ingestion of animal tissues, in the later stages is a feature of the life cycle of many aquatic insects. Temperature interacts with both food quality and quantity in effects on growth as well as having a direct effect on control of metabolism. Thus further elaboration of the role of food in life history phenomena will require controlled field or laboratory studies to partition the effects of temperature and food.

5308 **Secondary production mechanisms of continental shelf communities.** Pomeroy, L.R. (Univ. of Georgia, Athens). Contract EY-76-S-09-0639. pp 163-186 of Ecological processes in coastal and marine systems. Livingston, R.J. (ed.). New York, NY; Plenum Publishing Corp. (1979).

A compartmental model of energy flux through a continental shelf ecosystem is presented which examines the potential for significant energy flow through detritus, microorganisms, and dissolved material to terminal consumers. A number of assumptions are examined which have bearing on the outcome of the modeling exercise. Evidence is reviewed that primary production may be substantially higher than the usual ^{14}C method indicates. Evidence is presented that the input of primary detritus (new plant material) is a significant one, although relatively little of it is present in samples of particulate matter. Secondary detritus, principally fecal material, takes many forms and is involved in both benthic and pelagic food webs. Since there is little agreement about the significance of energy flux through detritus, dissolved material, and microorganisms, a model was constructed so that all, one, or none of them could move a major fraction of the energy fixes by primary production. The results indicate that either conventional assumptions about ecological assimilation efficiency are low by a factor of 2-3, or current measurements of photosynthesis are low by a factor of 5-10. Situations in the real world are described which may result in shifts of energy flux from direct consumption of phytoplankton by grazers to consumption of microorganisms which are growing on detritus and dissolved materials.

5202 Chemicals Monitoring And Transport

5309 **(ANL/ES—86) Transport of particulate matter by shearing currents in Lake Erie.** Dettmann, E.H. (Argonne National Lab., IL (USA)). Oct 1980. Contract W-31-109-ENG-38. 29p. NTIS, PC A03/MF A01.

The trajectories of particles sinking in a water body may be calculated from the ambient current configuration if sinking speeds are high enough that diffusional effects may be considered negligible. Particle trajectories are calculated for some sample current configurations, including vertical shear, and used to determine distance and direction of net horizontal transport in terms of particle sinking velocity. Spatial distributions of deposition rates for introduced particles having a known distribution of sinking velocities (particle sizes) are similarly determined. Sinking particles follow curvilinear trajectories in the presence of vertical shear. Because current speed usually decreases with increasing depth in the water column, net horizontal transport distances are less than those calculated using only the current speed at the depth of particle release. Net horizontal transport distances are further restricted if current direction changes with depth. The horizontal direction of a sinking plume rotates with increasing depth in the same sense as the current vector.

5310 **(BNL—28659) Fate of nutrient enrichment on continental shelves as indicated by the C/N content of bottom sediments.** Walsh, J.J.; Premuzic, E.T.; Whitledge, T.E. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 37p. NTIS, PC A03/MF A01.

The trajectory and fate of particulate matter are poorly understood processes in a spatially heterogeneous coastal ocean. Parameterization of appropriate hydrodynamics for a quantitative description of these loss processes must thus await definition of the important biological time and space scales. Since the bottom sands tend to record the history of the water column, we have selected the C/N content of shelf sediments as a possible tracer of (1) sites of nutrient introduction to the shelf by various physical mechanisms, of (2) areas of subsequent downstream utilization by the phytoplankton, and of (3) where loss of particulate matter might occur from the water column. An analysis is made of the C/N patterns of bottom surface sediments in relation to the nitrogen sources from upwelling, river runoff, and tidal mixing on the Peruvian, west African, Amazonian, Gulf of Mexico, eastern US, Bering, and North Sea shelves in an initial attempt to proscribe the particle trajectories of organic matter on the continental shelf.

5311 **(PB—80-166598) Assessment of energy resource development impact on water quality: the Tongue and Powder River Basins. Final report.** Melancon, S.M.; Hess, B.C.; Thomas, R.W. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Dec 1979. 216p. NTIS, PC A10/MF A01.

The primary objective of this report is to evaluate the existing water quality monitoring network in the Tongue and Powder River Basins and to recommend needed modifications to the present sampling program. As a basis for these recommendations, known developments, both present and planned, are discussed, and available data examined. The impact of developers on both water quality and quantity is defined. Two areas of particular concern are coal strip mining activities in the vicinity of Sheridan and oil field operations in the Salt Creek watershed.

5312 **(PB—80-173727) USNS Potomac oil spill, Melville Bay, Greenland, 5 August 1977. A joint report on scientific studies and impact assessment by the NOAA-USCG Spilled Oil Research Team and the Greenland Fisheries Investigations, Ministry for Greenland.** Grose, P.L.; Mattson, J.S.; Petersen, H. (National Oceanic and Atmospheric Administration, Washington, DC (USA). Environmental Data and Information Service). Aug 1979. 139p. NTIS, PC A07/MF A01.

This report presents the studies and findings of the NOAA-USCG Spilled Oil Research and Greenland Fisheries Investigations, Ministry for Greenland teams which responded to study the spill. In summary, the fate of the 107,000 gallons of spilled Bunker-C fuel was that 33% evaporated; the major part of the remaining seems to have sunk in 1,000 meters of water over a large area of Melville Bay and a small part remained on the surface as small pancakes. A very small amount of the oil was accommodated into the water column. Melville Bay is not a highly bioproductive area in terms of fisheries, although it is important as a native sealing area. It was concluded that the oil spilled from the USNS Potomac significantly contributed to the pollution of Melville Bay which normally has very low petroleum hydrocarbon levels in its surface waters. This incident probably had no lasting effect on the ecology of the region.

5313 (PB—80-174170) Oil spill sampling strategy. Smith, W. (Woods Hole Oceanographic Institution, MA (USA)). 1979. 11p. NTIS, PC A02.

A strategy for oil spill surveys is outlined. It depends on over-sampling in the first survey, and recording easy-to-measure variables associated with each sample. In the second stage, the samples are sub-sampled for the more expensive and time-consuming biological and chemical analysis. This procedure is an extension of double sampling. This kind of survey is easy to implement on short notice and, because it is based on classical sampling theory, the survey's results should be relatively easy to defend in administrative and legal proceedings.

5314 (PNL-SA—8353) Mathematical transport modeling for determination of effectiveness of Kepone clean up activities in the James River estuary. Onishi, Y. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 18p. (CONF-8010123—1). NTIS, PC A02/MF A01.

From 9. world dredging conference; Vancouver, Canada (29 Oct 1980).

During the period of 1966-1975, a highly chlorinated pesticide, Kepone, was discharged to the environment around Hopewell, Virginia. Much of the Kepone that reached the James River estuary was adsorbed by river sediment, becoming a long-term source of pollution. In order to identify an optimal location to remove Kepone from the river bed and to assess the effectiveness of the clean up activities to reduce the Kepone level in the river, the mathematical simulation of sediment and Kepone transport in the James River estuary was performed by applying the sediment-containment transport model, FETRA, to an 86-km river reach between Bailey and Burwell Bays. The FETRA code is an unsteady, two-dimensional, finite element interactions. The submodels are: (1) a sediment transport submodel, (2) a dissolved contaminant transport submodel, and (3) a particulate contaminant (contaminant adsorbed by sediment) transport submodel. FETRA also predicts changes in river bed conditions of sediment and contaminant. The value of applying models to dredging activity goes beyond this specific example. Through the sensitivity analysis, one can employ models to predict the most cost effective strategy for dredging. Properly constructed strategies will take advantage of river and coastal water dynamics to reduce the total volume of sediments to be dredged. Results of the simulation can also be used to predict subsequent environmental impacts.

5315 Effect of a march on runoff: I. a water-budget model. Huff, D.D.; Young, H.L. *USJournal of Environmental Quality (U.S.);* **9**: No. 4, 633-644(1980).

A water-budget model was developed to aid the study of transport of nutrients in surface and subsurface flows across a marsh. The model is based on field studies of Wingra marsh adjacent at Lake Wingra in Madison, Wis., and was used to calculate monthly totals of actual evapotranspiration, surface runoff, and subsurface drainage from April 1970 through August 1976. About 90% of the water entering the marsh comes from urban storm runoff. The remainder is precipitation (8%) and deep ground-water inflow (2%). Water leaves the marsh through evapotranspiration (7%), shallow ground-water discharge (8%), and surface outflow (85%). The model was used to estimate the water-table elevation at an observation well where direct measurements were taken (November 1975 through October 1976). The observed depth to the water table ranged from 0 to 150 cm below the surface and the simulated value usually was within +- 10 cm. This suggests that the model adequately computes the water budget for the marsh and provides a sound basis for calculating dissolved and suspended materials loads transported through the marsh into Lake Wingra.

5316 Determination of mononuclear dissolved aluminum in near-neutral waters. May, H.M.; Helmke, P.A.; Jackson, M.L. (Univ. of Wisconsin, Madison). *NLChemical Geology (Netherlands)rmatology See Chung Hua P'i Fu K'o Tsa Chih;* **24**: 259-269(1979).

Concentrations of mononuclear dissolved Al are determined in samples of natural waters and of solutions separated from experimental suspensions of clay minerals, by solvent extraction and spectrophotometry of aluminum 8-hydroxyquinoline. Preliminary extractions with chloroform solutions eliminate interferences due to dissolved V, Fe, Ni, Cu, Ga, Mo and U. Extracting the Al-hydroxyquinoline complex at pH 8.3 eliminates any interference due to F. The procedure was used to measure the solubility of gibbsite over the pH range 5-8.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 4570, 5281, 5294, 5297

5317 (CONF-801107—44) Applicability of Gaussian plume dispersion parameters to acute radionuclide releases. Miller, C.W.; Fields, D.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The Gaussian plume atmospheric dispersion model is one of the most widely used models for assessing the impact of radionuclides released to the atmosphere. This model is a statistical solution to the basic atmospheric diffusion equation. As a result, the Gaussian model should give more accurate results when used to calculate average air concentrations from long-term releases rather than for short-term concentrations from acute releases. However, the Gaussian model is routinely applied to such short-term radionuclide releases. The purpose of this paper is to examine the applicability of standard plume dispersion parameters for calculations of air concentrations resulting from such acute releases.

5318 Concentrations of /sup 113m/Cd in the marine environment. Noshkin, V.E.; Wong, K.M.; Eagle, R.J.; Anglin, D.L. (Univ. of California, Livermore). Contract W-7405-ENG-48. *GBNature (London) (England);* **287**: 221-223(18 Sep 1980).

Reports on the detection of /sup 113m/Cd in any type of environmental sample have been rare. The 113 mass chain yield is small relative to other longer-lived fission products, such as ^{90}Sr and ^{137}Cs, produced from uranium, plutonium and thorium fissions. Also, only a small fraction of the 113 chain yield decays to /sup 113m/Cd. Salter estimated that the /sup 113m/Cd/^{90}Sr activity quotient in thermonuclear fission should be 0.003. He stated that this ratio is in good agreement with data from a few samples measured in the northern hemisphere prior to 1962 which have no ^{109}Cd. This, to our knowledge, was the first report of the detection of fission-produced /sup 113m/Cd in the environment. Salter also calculated that 0.062 MCi of /sup 113m/Cd and 0.25 MCi of ^{109}Cd were produced by activation during the atmospheric detonation of the 1.4-megaton Starfish device on 9 July 1962 over Johnston Atoll. As both ^{109}Cd and /sup 113m/Cd are produced during neutron activation of stable cadmium, and ^{109}Cd is not a fission product, the last part of Salter's statement is significant. The absence of ^{109}Cd in samples collected before 1962 indicates that all nuclear testing before this time, which included all tests conducted at Enewetak and Bikini Atolls in the Marshall Islands, could have generated /sup 113m/Cd only as a fission product. It is therefore important to recognize that /sup 113m/Cd could be present in other environments contaminated with fission product wastes discharged to the aquatic environment from other nuclear facilities. / sup 113m/Cd has a half life of 14.6 +- 0.1 y and decays predominantly by beta-particle emission. We present here a preliminary report of /sup 113m/Cd concentrations measured in sediment and tissue samples of marine organisms collected around different atolls in the Marshall Islands.

5204 Thermal Effluents Monitoring And Transport

5319 (DOE/EV/05486—3) West Florida Continental Shelf: a study of geothermal flows and other processes affecting radionuclides and trace metals. Progress report, October 1, 1979-July 1, 1980. Fanning, K.A.; Byrne, R.H.; Betzer, P.R. (University of South Florida, St. Petersburg (USA). Dept. of Marine Science). 1980. Contract AS05-77EV05486. 38p. NTIS, PC A03/MF A01.

Research progress is reported for the period October 1979-July 1980. Physical and chemical investigations have been made of

the single known geothermal discharge on the West Florida Continental Shelf. It was discovered the discharge phenomenon is of regional extent. The origin of the discharges is normal seawater which enters the substrate of the Floridian plateau. The discharges are enriched in Ra 226 and Rn 222, heavy metals (Pb, Ca), and calcium, and depleted in magnesium. The effects of these thermal discharges on the shelf environment were investigated. (ACR)

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 4678

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 5323

5320 **(PB—80-169733) Republic of Korea: an example of integrated regional development.** Evans, D.D. (Denver Research Inst., CO (USA)). Dec 1979. 24p. NTIS, PC A02/MF A01.

The case history has been written to assist development planners, personnel of industrial research institutes, and USAID mission personnel in understanding the role that IRIs can and do play in the application of technology to development. It describes the Korea Institute of Science and Technology's (KIST) efforts to provide regional development on a 703 square mile island. Research and Development includes programs for producing a high-nutrition cattle feed, improved orange processing and shipping methods, design and partial testing of a small, wind-powered electric generating system, and other technical and economic studies.

5321 **(PNL—3403) Community stress and social and technological change: a framework for interpreting the behavior of social movements and community action groups.** Perry, R.W.; Schuller, C.R.; Lindell, M.K.; Greene, M.R.; Walsh, J.T.; Earle, T. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Jun 1980. Contract AC06-76RL01830. 158p. (B-HARC—411/80/034). NTIS, PC A08/MF A01.

The purpose of this report is to provide a comprehensive examination of existing research on community organizations and community political systems. These findings will be integrated into a framework for understanding the variety of social and political responses which may be manifest in small communities facing the prospect of hosting a major nuclear facility. The principal focus is on the formation and behavior of social groups in communities, particularly politically oriented social movements or community action groups. This analysis is set on the context of a community experiencing social stress. Most of the discussion which follows is based on an extrapolation from the large body of reseach literature on the topics in sociology, political science, and psychology. Chapter I examines the community political systems which are the arena in which local action groups will operate. Chapter II focuses on the internal conditions necessary for the formation and maintenance of community action groups. Chapter III reviews the research literature on the social environment of organizations in communities and the external conditions which are necessary to maintain organizations over time. Chapter IV develops a logic whereby the community consensus model can be adopted to particular social movement organizations and community actions groups. Chapter V examines changes in aspects of the environment which can be a function of the operation of movement organizations, and changes in the structure and tactics of movement organizations which appear to be a response to the environment.

5302 Assessment Of Energy Technologies

5322 **(CONF-8010118—1) Risks in perspective: natural, occupational, and de minimus.** Richmond, C.R. (Oak Ridge National Lab., TN (USA)). 23 Oct 1980. Contract W-7405-ENG-26. 29p. NTIS, PC A03/MF A01.

From 68. national safety congress and exposition; Chicago, IL, USA (23 Oct 1980).

The author uses mortality rates and death statistics in the US to illustrate methodology, comparative risk, and risk assessments with the purpose of setting realistic radiation protection standards. (PSB)

5323 **(DOE/EV/10092—1) Introduction to the Strategic Environmental Assessment System.** Narkus-Kramer, M.; Rebibo, K.; Borko, B.; Dossani, N.; Hutchison, R.; Smith, B.; Weiss, A. (Mitre Corp., McLean, VA (USA). METREK Div.). Oct 1980. Contract AC02-79EV10092. 72p. NTIS, PC A04/MF A01.

The Strategic Environmental Assessment System (SEAS) is an integrated set of computer programs and associated data bases used to project and analyze national and regional environmental trends. The two major users of SEAS are the Department of Energy (DOE) and the Environmental Protection Agency (EPA). These agencies use SEAS to project the likely emissions of key pollutants given specific assumptions concerning environmental regulations, future levels of energy supply, and economic activity. This introduction to SEAS discusses how the model has been used in specific applications, the general model structure, the data base, and the available documentation.

5303 Environmental Impact Statements

5324 **(DOE/EIS—0064(Vol.1)) Rocky Flats Plant site, Golden, Jefferson County, Colorado. Final environmental impact statement (final statement to ERDA 1545-D).** (Department of Energy, Washington, DC (USA)). Apr 1980. 509p. NTIS, PC E10/MF E10.

This final Environmental Impact Statement (FEIS) incorporates a number of changes as a result of the comments and suggestions received on the Draft Environmental Impact Statement. The major additions and revisions of this first of the three-volume statement are discussed. Chapter titles are: summary; background; environmental impacts; unavoidable adverse environmental effects; alternatives; relationship between short-term uses and long-term productivity; relationship to land-use plans; irreversible and irretrievable commitments of resources; and, environmental trade-off analysis. Chapter 2 includes updated information on seismic stability of the area and seismic design criteria are presented. A mechanism for dissemination of the data from seismic studies in progress is specified. The Plant's personnel protection program with respect to nonradioactive materials, Plant security systems, and the emergency plans of the Plant and the State of Colorado are discussed in greater detail. Material on the environmental monitoring program was updated to reflect current monitoring and measuring conditions. Discussions of various soil sampling methods, plutonium background levels in soil, and plutonium soil standards, are presented. The dose calculations in Chapter 3 were extended to include comparisons of organ doses to natural background organ doses as well as the dose to the whole body. Doses to women and children are considered by exposure pathway as well as those for Standard Man. All credible accident scenarios were reviewed and details updated. A comprehensive discussion of genetic and health effects is presented in Appendices G-2 through G-4. Chapter 5 was revised to reflect the effort and cost involved in decontaminating soil, both onsite and offsite, relative to various decontamination criteria which might be employed.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 5400, 5435, 5468, 5469, 5478, 5483, 5484

5325 **Suppression of the biosynthesis of guanosine triphosphate by protein synthesis inhibitors.** Volkin, E.; Boling, M.E.; Jones, M.H.; Lee, W.H.; Pike, L.M. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *USJournal of Biological Chemistry, The (U.S.);* **255**: No. 19, 9105-9109(10 Oct 1980).

In a prior report it was observed that CTP synthesis and concomitant incorporation of CMP into RNA and dCMP into DNA were markedly reduced in cells cultured in the presence of cycloheximide and puromycin. Experiments described here with Novikoff hepatoma cells reveal that the purine biosynthetic pathway is similarly affected. When the cells are subjected to cycloheximide (30 or 60 μg/ml) or puromycin (100 μg/ml), there is a substantial reduction in the bioconversion of hypoxanthine, adenosine, and deoxyadenosine into guanylate compared to untreated cultures. Whereas synthesis (counts per min/nmol) of pool ATP was 70 to 100% of controls, that of pool GTP was 20 to 35% of controls. Incorporation of AMP into RNA was 40 to 60% of controls, but that of GMP was only 10 to 25% of controls. Incorporation of dAMP into DNA averaged 10% of controls, but that of dGMP was only 4% of controls. Synthesis of guanylates from formate by the de novo pathway was similarly reduced, but incorporation of guanosine, which enters via kinase action alone, was not disproportionately lowered. These results suggest that protein synthesis inhibitors cause a severely reduced availability of newly synthesized GTP and CTP as well as their deoxy counterparts, dGTP and dCTP, the proximal precursors for the synthesis of RNA and DNA. However, the nanomolar levels of all nucleoside triphosphates remain high, probably as a result of recycling of nucleic acid breakdown products. Thus, reduced synthesis of these compounds may restrict nucleic acid synthesis only of some sort of compartmentation leads to a limitation of these precursors at the site(s) of nucleic acid synthesis.

5326 Affinity labeling and characterization of the active site histidine of glucosephosphate isomerase. Gibson, D.R. (North Texas State Univ., Denton); Gracy, R.W.; Hartman, F.C. Contract W-7405-ENG-26. *USJournal of Biological Chemistry, The (U.S.);* **255**: No. 19, 9369-9374(10 Oct 1980).

N-bromoacetylethanolamine phosphate was found to act as a specific affinity label for the active center of glucosephosphate isomerase. The inactivation process followed pseudo-first order kinetics, was irreversible, and exhibited rate saturation kinetics with minimal half-lives of inactivation of 4.5 and 6.3 min for the enzyme isolated from human placenta and rabbit muscle, respectively. The pH dependence of the inactivation process closely paralleled the pH dependence of the overall catalytic process with pK/sub a/ values at pH 6.4 and 9.0. The stoichiometry of labeling of either enzyme, as determined with N-bromo[$^{14}C_2$]acetylethanolamine phosphate, was 1 eq of the affinity label/subunit of enzyme. After acid hydrolysis and amino acid analysis of the radioactive affinity-labeled human enzyme, only radioactive 3-carboxymethyl histidine was found. In the case of the rabbit enzyme, the only radioactive derivative obtained was 1-carboxymethyl histidine. Active site tryptic peptides were isolated by solvent extraction, thin layer peptide fingerprinting, and ion exchange chromatography before and after removal of the phosphate from the active site peptide. Amino acid analysis of the labeled peptides from the two species were very similar. Using high sensitivity methods for sequence analysis, the primary structure of the active site was established as Val-Leu-His-Ala-Glu-Asn-Val-Asp (Gly,Thr,Ser) Glu-Ile (Thr-Gly-His-Lys-Glx)-Tyr-Phe. Apparent sequence homology between the catalytic center of glucosephosphate isomerase and triosephosphate isomerase suggest that the two enzymes may have evolved from a common ancestral gene.

5327 Renaturation of enzymes after polyacrylamide gel electrophoresis in the presence of sodium dodecyl sulfate. Lacks, S.A.; Springhorn, S.S. (Brookhaven National Lab., Upton, NY). *USJournal of Biological Chemistry, The (U.S.);* **255**: No. 15, 7467-7473(10 Aug 1980).

A number of enzymes, including amylases, dehydrogenases, and proteases, were shown to be renaturable after polyacrylamide gel electrophoresis in the presence of sodium dodecyl sulfate. Enzyme activity was detected in situ by action on substrates introduced into the gel and subsequent staining of either the product or unreacted substrate. Enzymes appeared to recover activity as soon as the detergent diffused out of the gel. Renatured enzymes were retained in gels after electrophoresis longer than native enzymes which had been subjected to electrophoresis in the absence of detergent. Re-electrophoresis of the renatured enzymes showed that part of the retained activity was physically anchored to the gel, possibly by the folding of polypeptides around the gel matrix as the enzymes were renatured.

5328 Synthesis and biological evaluation of p-bromospiperone as potential neuroleptic drug. Huang, C.C. (Argonne National Lab., IL); Friedman, A.M.; So, R.; Simonovic, M.; Meltzer, H.Y. (Argonne National Lab., IL). *USJournal of Pharmaceutical Sciences (U.S.);* **69**: No. 8, 984-986(Aug 1980).

p-Bromospiperone was prepared from the reaction of spiperone with bromine. It was tested for dopamine receptor binding affinity in vitro and its ability to stimulate prolactin secretion in vivo. The results indicate no significant change of biological activities due to the bromination of spiperone.

5329 Energetic factors affecting carbon dioxide fixation in isolated chloroplasts. Slovacek, R.E.; Hind, G. (Brookhaven National Lab., Upton, NY). *USPlant Physiology (U.S.);* **65**: No. 3, 526-532(Mar 1980).

Light- and HCO_3-saturated (10 millimolar) rates of O_2 evolution (120 to 220 micromoles O_2 per milligram chlorophyll per hour), obtained with intact spinach chloroplasts, are decreased up to 3-fold by changes in assay conditions such as omission of catalase from the medium, the use of high (≧ 1 millimolar) inorganic phosphate, inclusion of NO_2- as an electron acceptor, or bright illumination at low partial pressures of O_2. These inhibitions may be reversed by addition of uncoupling levels of NH_4Cl or of antimycin concentrations that partially block cyclic electron transfer between cytochrome b_6 and cytochrome f. Measurements of the pH gradient across the thylakoid membrane with the fluorescent probe, 9-aminoacridine, indicate that changes in ΔpH are sufficient to account for both the inhibited and restored rates of electron transport. It follows that the rate of HCO_3-saturated photosynthesis may be restricted by a proton gradient back pressure under these conditions. The rate of O_2 evolution is also decreased 3-fold when ambient CO_2 (0.63 millimolar HCO_3- at pH 8.1) is used in place of saturating HCO_3- and chloroplasts are illuminated aerobically with catalase and a low level (0.25 millimolar) of K_2HPO_4. Only inhibitory effects are observed with additions of antimycin or NH_4Cl. Under these conditions, excessive photophosphorylation or a large pH gradient does not limit the rate of photosynthesis.

5330 Role of inorganic phosphate in divalent-cation sequestration by mitochondria. Puskin, J.S.; Gunter, T.E.; Coene, M.T. (Univ. of Rochester, NY). *DEEuropean Journal of Biochemistry (Formerly Biochemische Zeitschrift) (West Germany);* **106**: 425-429(1980).

Rat liver mitochondria which have actively accumulated Mn^{2+} ions exhibit an electron paramagnetic resonance (EPR) spectrum dominated by a component E in which the usual hyperfine sextet has been collapsed to a single line through the process of spin exchange narrowing. When uptake occurs in the absence of added P/sub i/, the line width of E shows considerable variation. By comparing experimentally observed spectra with computer-generated simulations it is demonstrated however that, under these conditions, E can be as narrow as ≃ 190 Oe, considerably narrower than the spectrum from a manganese phosphate precipitate. It is concluded therefore that the spectral component E, obtained under these conditions, cannot be accounted for in terms of manganese phosphate precipitate.

5331 Effect of paraquat on microsomal lipid peroxidation in vitro and in vivo. Kornbrust, D.J.; Mavis, R.D. (Univ. of Rochester, NY). *USToxicology and Applied Pharmacology (U.S.);* **53**: 323-332(1980).

Rat lung and liver microsomes did not undergo lipid peroxidation in the absence of iron when incubated with NADPH and concentrations of paraquat ranging from 10^{-7} to 10^{-2} M. Paraquat also did not stimulate rat liver and lung microsomal peroxidation induced by added iron and NADPH, and was inhibitory at concentrations above 10 μM. Similarly, no stimulation of peroxidation was produced by paraquat in rabbit or human lung microsomes; however, under similar conditions, paraquat enhanced NADPH/iron-dependent peroxidation in mouse lung and liver microsomes obtained from rats sacrificed at 12, 18, and 24 hr following a lethal dose of paraquat (50 mg/kg, ip), there was no loss of vitamin E or increase

in susceptibility to in vitro peroxidation which would be expected if lipid peroxidation had occurred in vivo although extensive lung damage developed during this time period. These results indicate that paraquat does not cause pulmonary toxicity by initiating peroxidation of lung lipids, and the decrease of palmitate in paraquat-damaged lungs is consistent with inhibition of fatty acid synthesis as an early event in the pathogenesis of paraquat toxicity.

5332 **Complex structure of the membrane nuclease of streptococcus pneumoniae revealed by two-dimensional electrophoresis.** Rosenthal, A.L.; Lacks, S.A. (Brookhaven National Lab., Upton, NY). *GBJournal of Molecular Biology (England);* **141**: 133-146(1980).

A nuclease of Streptoccus pneumoniae, previously implicated in DNA transport during genetic transformation, was analysed in crude extracts and cell fractions by novel technique for detecting enzyme activity after gel electrophoresis in the presence of sodium dodecyl sulfate. The nuclease activity corresponded to a polypeptide of 25,000 molecular weight; its absence in mutants defective in DNA transport and its presence in the membrane of normal cells were confirmed. When protected from proteolysis by addition of α-toluene-sulfonyl fluoride, the membrane nuclease was found by gel filtration to be in a complex with an apparent molecular weight of approximately 250,000. Proteolysis of the complex released both intact and degraded nuclease monomers. The discrete nature of the complex was demonstrated by two-dimensional gel electrophoresis. A hypothetical model envisages the membrane nuclease complex to be a doughnut-like structure with an aqueous pore through which one strand of DNA passes into the cell as the complementary strand is degraded by the nuclease action.

5333 **Relative susceptibility of microsomes from lung, heart, liver, kidney, brain and testes to lipid peroxidation: correlation with vitamin E content.** Kornbrust, D.J.; Mavis, R.D. (Univ. of Rochester, NY). *USLipids (U.S.);* **15**: No. 5, 315-322(1980).

Rates of in vitro lipid peroxidation of microsomes and homogenates were found to vary widely among different tissues and species. In rats and rabbits, lung microsomes peroxidized at 25- to 50-fold lower rate than liver, kidney, testes and brain microsomes. Heart microsomes peroxidized at a rate slightly greater than, but most similar to, lung microsomes. Comparison of tissue homogenates also revealed the unique resistance of lung and heart to lipid peroxidation. Higher rates of peroxidation in mouse lung microsomes relative to rabbit, rat and human lung microsomes were similarly correlated with a lower ratio of vitamin E to peroxidizable fatty acids in mouse lung microsomes. These data provide strong support for the role of vitamin E as the major cellular antioxidant, especially in the highly oxygenated tissues of heart and lung, and demonstrate the utility of the microsomal system in characterizing tissue differences in susceptibility to peroxidative membrane decomposition.

5334 **Redox properties of three bisulfite reductases from the sulfate-reducing bacteria.** Liu, C,L.; DerVartanian, D.V.; Peck, H.D. Jr. (Univ. of Georgia, Athens). *USBiochemical and Biophysical Research Communications (U.S.);* **91**: No. 3, 962-970(14 Dec 1979).

The redox properties of purified bisulfite reductases from Desulfovibrio gigas, D. desulfuricans (Norway) and Desulfotomaculum ruminis, containing non-heme iron and siroheme have been studied by EPR spectroscopy. Each enzyme shows ferric siroheme EPR signals which are not completely reduced by dithionite after 20 min, but are readily reduced within 1 min by dithionite plus methyl viologen. Reaction of each reductase with reduced methyl viologen results in reduction of only the siroheme. These results suggest different redox potentials for the iron-sulfur and siroheme moieties, and indicate that their functional properties are similar for each reductase.

5335 **Selectivity of the excision of alkylation products in a xeroderma pigmentosum-derived lymphoblastoid line.** Altamirano-Dimas, M.; Sklar, R.; Strauss, B. (Univ. of Chicago, IL). *NLMutation Research (Netherlands)Absorbed Newsl. Environ. Mutagen Soc.;* **60**: 197-206(1979).

Lymphoblastoid cells derived from a complementation group C xeroderma patient were unable to remove 06-methyl guanine residues formed in DNA by treatment of cells with low concentrations of N-methyl-N'-nitro-N-nitrosoguanidine (MNNG). The xeroderma cells were competent in their ability to excise 3-methyl adenine adducts. MNNG treatment induced excision repair in the xeroderma line and in addition the treatment resulted in the presence of numerous single-strand breaks in the DNA. The single gene, uv-excision-defective mutants of Escherichia coli, uvrA and uvrB, are able to excise MNNG-induced 06-methyl guanine adducts indicating that excision of this compound is not due to operation of the uv endonuclease system.

5336 **Carbohydrate composition of immunoglobulins from diverse species of verterbrates.** Acton, R.T.; Niedermeier, W.; Weinheimer, P.F.;Clem, L.W.; Leslie, G.A.; Bennett, J.C. (California Inst. of Technology, Pasadena). *US-Journal of Immunology (U.S.);* **109**: No. 2, 327-381(Aug 1972).

Immunoglobulins and their respective heavy (H) and light (L) polypeptide chains from species representing the major classes of vertebrates were analyzed for their carbohydrate composition by gas chromatography of the alditol acetate derivatives of the monosaccharides released by acid hydrolysis. Mannose, galactose, glucosamine and sialic acid were present in the immunoglobulins from all the species investigated. Most of the carbohydrate was found associated with the H chains. Whereas species representative of the mammals and birds had mannose to galactose ratios greater than one, the ratio to these sugars to each other in the immunoglobulins from animals below the birds was on the order of one.

5503 Cytology

5337 **(DOE/ER/73019—57) Studies on the control of cell wall extension. Progress report, September 1, 1979-August 31, 1980.** Cleland, R.E. (Washington Univ., Seattle (USA). Dept. of Botany). 24 Sep 1980. Contract AT06-76ER73019. 22p. NTIS, PC A02/MF A01.

The growth rate of plant cells can be defined in terms of five parameters: the hydraulic conductivity of the tissue (L'p), the rate of export from the cell to the wall of a wall loosening factor (dW/dt), the capacity of the wall to be loosened in response to the wall loosening factor (WLC), the osmotic potential of the cells and outside solution (π/sub c/ and π/sub o/, respectively), and the yield threshold for wall expansion (Y). The study assesses each of these parameters under conditions where growth is being enhanced or inhibited, with the purpose of explaining at the cellular level just how growth is being controlled. (ACR)

5338 **Light microscopic analysis of the three-dimensional structure of higher plant chloroplasts. Position of starch grains and probable spiral arrangement of stroma lamellae and grana.** Wildman, S.G.; Jope, C.A.; Atchison, B.A. (Univ. of California, Los Angeles). Contract EY-76-S-03-0034. *USBotanical Gazette (Chicago) (U.S.);* **141**: No. 1, 24-36(Mar 1980).

Light microscopic observations of grana-containing chloroplasts in living cells of leaves of numerous species of plants, including both monocotyledons and dicotyledons, have allowed specification of numerous parameters of chloroplast structure. Chloroplasts are thin and saucer-shaped, with the convex surface facing the cell wall and the concave surface facing the vacuole. The thickness of the grana-containing and starch-containing region of chloroplasts does not exceed 2 μm although the length may reach more than 15 μm in chloroplasts containing 150 grana. The grana do not overlap each other and are in a plane of focus above that of the starch grains. The grana are tilted with respect to each other and are located at varying levels with respect to the convex surface of the chloroplast. In slightly disrupted, isolated chloroplasts, the grana are sometimes arranged in rows and serially connected to each other by a fine thread. In living cells, some chloroplasts exhibit a distinct spiral arrangement of the grana. Using these observations and the dimensions derived from them, a new conception of the three-dimensional structure of the grana-containing region of the chloroplast has been obtained. In this conception, the grana are uniformly thin, nonoverlapping cylinders, connected in a single series as in a string of beads and wound into a slightly raised spiral (a helix). Starch grains, when present, are located in the concavity of

the helix. The length of the string of grana determines the area of the grana-containing region of a chloroplast.

5339 Computer analysis of a spiral, string-of-grana model of the three-dimensional structure of chloroplasts. Jope, C.A.; Atchison, B.A.; Pringle, R.C. (Univ. of California, Los Angeles). Contract EY-76-S-03-0034. *USBotanical Gazette (Chicago) (U.S.);* **141**: No. 1, 37-47(Mar 1980).

Using uniform grana whose diameter:thickness ratio was 5:1, a spiral, string-of-grana chloroplast model was constructed in a computer as a system of three-dimensional coordinates. None of the grana overlapped each other, and starch grains occupied the cavity beneath the spiral arrangement of grana. Visualization of internal organization was possible by examining computer-produced graphic plots of simulated sections through the model. The dimensions and form of the model were derived from light-microscopic observations of chloroplasts in living cells, except that the thickness of a thylakoid was obtained from published measurements made on electron micrographs. The computer-simulated sections, in the form of graphic plots, show a high degree of similarity to electron micrographs of in situ chloroplasts. Both have what appear to be overlapping grana; both have starch grains that appear intercalated between grana; both have grana of seemingly varying thicknesses and occasionally of irregular shape; and both exhibit long sets of continuously interconnected grana. No conflict was encountered between electron micrographs of actual chloroplasts and the simulated sections of the computer model. Therefore, the spiral model, based on conception of a string of grana of uniform thinness, appears to be a satisfactory representation of in vivo chloroplast structure.

5340 Genetic variation in mouse thymocyte antigens detected by heteroantisera. Douglas, T.B.C. (California Inst. of Technology, Pasadena). *USTransplantation (Formerly Transplantation Bulletin) (U.S.);* **16**: No. 3, 265-268(Sep 1973).

The theta antigen of the mouse provides a cell surface marker for Thymus-derived lymphocytes. The allelic variants of this antigen, Thy 1.1 and Thy 1.2, are expressed by the Thy-1a and Thy-1b alleles. The strain distribution and genetic segregation data presented here show that reagents specific for the Thy-1.2 antigen of the mouse can be prepared by the absorption of heteroantisera raised in rats. It seems likely that the capacity of rats to produce specific anti-Thy-1.2 antibodies is associated with their possession of a self antigen indistinguishable from Thy-1.1. In any case, rat antisera now appear to be a ready source of reagents for the detection of at least one class of lymphocyte alloantigens in the mouse.

5504 Genetics

REFER ALSO TO CITATION(S) 5442, 5453, 5476

5341 Transferrin polymorphism and Hardy-Weinberg Ratios. *USAmerican Naturalist, The (U.S.);* **107**: No. 954, 314-317(Mar 1973).

The iron-binding protein, transferrin, is polymorphic in almost all vertebrate species in which it has been studied. In pigeons, the two alleles, Tf/sup A/ and Tf/sup B/, are present in approximately equal frequency in populations widely scattered throughout the world. A mechanism to account for the gene-frequency stability has recently been proposed.

5505 Metabolism

5342 Mechanisms of electron flow in photosystem II and toward photosystem I. Velthuys, B.R. (Martin Marietta Labs., Baltimore, MD). *USAnnual Review of Plant Physiology (U.S.);* **31**: 545-567(1980).

In the thylakoid membrane of chloroplasts, the conversion of light into chemical energy is accomplished via a series of reactions that include two photoreactions, the primary reactions of two photosystems. Photosystem II (PS II) oxidizes water and reduces plastoquinone. Photosystem I (PS I) oxidizes plastocyanin and reduces ferredoxin and, via the ferredoxin, reduces $NADP^+$. This series of reactions also leads to the phosphorylation of ADP to ATP via protons translocated across the membrane. Central subjects of this review are (a) the oxidation of water and (b) the redox reactions of plastoquinone.

5343 Regulation of Na^+-dependent sugar transport in intestinal epithelial cells by exogenous ATP. Kimmich, G.; Randles, J. (Univ. of Rochester, NY). *USAmerican Journal of Physiology, The (U.S.)erican Journal of Physiology: Endocrinology, Metabolism and Gastrointestinal Physiology (U.S.);* **238**: No. 7, C177-C183(1980).

Exogenous ATP (1 mM) exerts a dramatic biphasic effect on the accumulation of 100 μM 3-O-methylglucose by isolated intestinal epithelial cells. The initial effect ensues approximately 15 s after exposure and inhibits 80% of the undirectional sugar influx. Cellular phosphatases totally degrade the added ATP within a period of 20 min leading to a reactivation of transport capability. The cells exposed to ATP ultimately establish a concentration gradient of sugar about twice that observed for control cells. Pyrophosphate (10 mM) delays the degradation of added ATP and prolongs the interval of transport inhibition. It seems likely that the early effect represents a direct modification of carrier capability rather than an affect mediated via an alteration of cellular energetics.

5506 Medicine

5344 (LBL—11728) Contribution of modern medical imaging technology to radiation health effects in exposed populations. Fabrikant, J.I,. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., San Francisco (USA). School of Medicine). Nov 1980. Contract W-7405-ENG-48. 17p. (CONF-801103—18). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The introduction of technically-advanced imaging systems in medicine carries with it potential health hazards, particularly from ionizing and nonionizing radiation exposure of human populations. This paper will discuss what we know and what we do not know about the health effects of low-level radiation, how the risks of radiation-induced health effects may be estimated, the sources of the scientific data, the dose-response models used, the uncertainties which limit precision of estimation of excess health risks from low-level radiation, and what the implications might be for radiation protection in medicine and public health policy.

5345 (PB—80-810534) Radiotherapeutic agents and techniques (citations from the NTIS data base). Report for 1976-May 80. Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). May 1980. 229p. NTIS PC N01/MF N01.

Research reports are cited on the use of gamma rays, x-rays, protons, neutrons, heavy ions, negative pions, and radioisotopes in radiotherapy. The bibliography includes data on particle accelerators, dosimetry, and health physics. The effectiveness of radiation for the treatment of cancer and hyperthyroidism is emphasized. (This updated bibliography contains 222 abstracts, 56 of which are new entries to the previous edition.)

5346 Relationship of serum lipids to adrenal-gland uptake of 6β-[^{131}I] iodomethyl-19-norcholesterol in Cushing's syndrome. Valk, T.W.; Gross, M.D.; Freitas, J.E.; Swanson, D.P.; Schteingart, D.E.; Beierwaltes, W.H. (Univ. of Michigan, Ann Arbor). Contract EY-76-S-02-2031. *USJournal of Nuclear Medicine (U.S.);* **21**: No. 11, 1069-1072(Nov 1980).

From 28. annual meeting of the Society of Nuclear Medicine; Las Vegas, NV, USA (16 Jun 1981).

An alteration in serum cholesterol levels has been suggested as a possible modifier of adrenal uptake of the cholesterol analog, 6β-[^{131}I]iodomethyl-19-norcholesterol (NP-59). To assess the effect of hypercholesterolemia upon NP-59 adrenal uptake, patients with Cushing's syndrome (eight with pituitary-dependent, four with ACTH-independent, and two with ectopic-ACTH syndrome) were selected for retrospective analysis based on the availability of serum cholesterol ($n = 14$) and triglyceride ($n = 10$) concentrations obtained at the time of adrenal scintigraphy. A negative correlation ($r = -0.78$, $p < 0.01$) was found between NP-59 uptake and serum cholesterol levels in patients with pituitary-dependent Cushing's dis-

ease. Compared with pituitary-dependent disease, the ectopic-ACTH syndrome and ACTH-independent states demonstrated equal or greater adrenal uptake of NP-59 at similar serum cholesterol concentrations. Serum triglyceride concentrations did not correlate with total adrenal uptake of NP-59 in any of the patient groups studied. Increased serum cholesterol concentrations are associated with diminished adrenal uptake of NP-59, and in some cases may limit the diagnoic efficacy of adrenal scintigraphy in Cushing's syndrome.

5347 **Tissue implantation method and apparatus.** Doss, J.D. (to Dept. of Energy). US Patent Application 100,665. 5 Dec 1979. 9p.

The disclosure describes the implantation of seeds of radioactive material into body tissue utilizing a cannula and anchor containing suture.

5348 **Radiopharmaceuticals. II.** Contract AC02-79EV10146. New York, NY; Society of Nuclear Medicine, Inc. (1979). 857p. (DOE/EV/10146—1; CONF-790321—).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Recorded are the proceedings of the 2nd International Symposium on Radiopharmaceuticals. Divisions of topics discussed are the production of radionuclides, the international regulatory affairs relating to radiopharmaceuticals; quality control of radiopharmaceuticals; recent advances in organic and inorganic radiopharmaceuticals; and uses of radiopharmaceuticals in imaging the central nervous system, lymphatic system, hematological processes, kidneys, cardiopulmonary system, liver, biliary tract, skeleton, thyroid, pancreas, prostate, and adrenal glands. (DLC)

5349 **/sup 99m/Tc-sulfur colloid: evaluation of preparation parameters for kits from four commercial manufacturers.** Fortman, D.L.; Sodd, V.J. (Bureau of Radiological Health, Cincinnati, OH). pp 15-23 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

This study investigated the adequacy of the preparation instructions listed in the package inserts of four commercial suppliers of /sup 99m/Tc-sulfur colloid kits. All of these kits utilize the reaction of an acid on sodium thiosulfate to produce the sulfur colloid. The labeling efficiency vs time of reaction, temperature of reaction, /sup 99m/Tc quantity, and effect of complexing agents and stabilizers were studied. With the exception of one manufacturer that listed water bath temperature specifications that could result in erratic labeling efficiencies, the instructions found in the package inserts were found to be adequate, and should be carefully followed.

5350 **Comparison of the rat and mouse model for monitoring the radiochemical purity of Tc-99m human serum albumin.** McLean, J.R.; Rockwell, L.J.; Welsh, W.J. (Radiation Protection Bureau, Ottawa, Ontario). pp 25-31 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Kits from 4 manufacturers were reconstituted according to package insert instructions. The radiochemical purity of each preparation was assessed by in vitro techniques prior to biological distribution studies in rats and mice. Tissues of interest were blood and liver. Analysis of variance (at $p = 0.05$) indicated that there was a significant difference between the tissue distribution results for rats and mice. Also, there was a significant difference between preparations based on the blood results for either rats or mice but not the liver results. Only the blood results reflected the in vitro test values.

5351 **Labeled proteins: criteria for quality.** Pettit, W.A.; Deland, F.H.; Blanton, L. (Nuclear Medicine Service, Lexington, KY). pp 33-42 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Several labeled protein preparations have been evaluated in regard to (1) contamination with unbound radionuclide, (2) high molecular weight radioactive contaminants, (3) stability of the radionuclide-protein bond, and (4) preservation of biological activity. Regardless of which radionuclide and labeling procedure is used, evaluation of the labeled protein can be effectively achieved by the assay procedures set forth. Iodine provides the most desirable products, followed by technetium and mercury in that order.

5352 **Acceptance testing of ^{123}I-sodium iodide solution produced by the ^{127}I(p,5n) ^{123}Xe → ^{123}I reaction.** Breslow, K.; Barnes, J.; Mak, S.K.; Study, K.T.; Rhodes, B.A. (Univ. of New Mexico, Albuquerque). pp 43-54 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Methods for rapidly assessing the pharmaceutical quality of ^{123}I-NaI solution produced by the (p,5n) reaction are discussed. A test to determine, within a short time, the radionuclidic acceptability of ^{123}I-NaI solution is described. This test, which is based on the initial ratios of the 159 keV gamma rays to the x-rays determined at the time of calibration, precludes dispensing radionuclidically impure ^{123}I-NaI solution. Techniques for quickly determining the radiochemical purity of radioiodine solutions are also discussed.

5353 **Effect of solubility on the biodistribution and evaluation of 16-[^{123}I]-9-hexadecenoic acid as a myocardial imaging agent.** Hoogland, D.R.; Weichert, J.P.; Sirr, S.A.; Frick, M.P.; Forstrom, L.A.; Loken, M.K. (Univ. of Minnesota, Minneapolis). pp 55-65 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

A method for synthesizing 16-[^{123}I]-9-hexadecenoic acid (IHDA) free of particulates and macro-colloids with a 75% final yield has been developed. Our results indicate biodistribution and product quality of myocardial imaging agents such as IHDA with short effective biological half times in blood and myocardial tissue can be evaluated in the mouse. The importance of ascertaining biodisposition in non-cardiac tissues when evaluating fatty acids as myocardial imaging agents was demonstrated. Initial dog studies demonstrated that IHDA has potential for imaging sites of decreased perfusion in the heart, and may be suitable for sequential rest and stress studies because of its short effective half time in myocardial tissue (15 to 20 minutes) and acceptable non-target activity levels.

5354 **Reevaluation of the contaminants in the 99-Mo 99m-Tc generator eluants.** Preiss, I.L. (Rensselaer Polytechnic Inst., Troy, NY); Frank, A.S.; Kishore, R. pp 67-72 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

There have been many studies to determine the level of contamination in generator produced 99m-Tc. Such studies are required so that reasonably accurate dose calculations, which include all radiations from a sample, can be made. We have conducted a set of experiments designed to establish the origin of the as yet unassigned 322 keV gamma-ray often observed as the major contaminant in generator-produced 99m-Tc eluant fractions: Classical radiochemical milking of daughter from parent + grandparent was employed along with high resolution gamma-ray spectroscopy. These experiments, in which energy and half-life were determined, indicate that the 322 keV gamma-ray is indeed the result of beta-decay of 99m-Tc. Our results do not preclude other beta or gamma decays from this parent.

5355 **Design and development of Te-123m radiopharmaceuticals.** Basmadjian, G.P.; Ice, R.D.; Magarian, R.A.; Parker, G.R.; Mills, S.L.; Kirschner, A.S. (Univ. of Oklahoma, Oklahoma City). pp 93-99 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Tellurium-123m has favorable physical characteristics, (159 keV γ isomeric transition photons, 84% abundance, t 1/2 119 d) and forms in many instances stable C-Te bonds, allowing for the synthesis of numerous compounds containing a γ-emitting radionuclide without affecting the parent molecule's physiological characteristics. The development of a quick method for solubilizing Te-123m metal into two inorganic nucleophiles in aqueous solution, i.e. NaHTe and Na_2Te_2, has facilitated the handling of Te-123m metal and the synthesis of new Te-123m radiopharmaceuticals. Nucleophiles with the structure $R\text{-}Te^-Na^+$ were prepared by the reaction of alkyl halides with NaHTe. Alkyl halides reacted with Na_2Te_2 produced stable, colored dialkyl ditellurides which could be reduced in situ to the desired sodium alkyl telluride nucleophiles. The reaction of these Te-123m labeled organic nucleophiles with short and long chain alkyl halides enables the synthesis of Te-123m fatty acid analogs.

5356 **Selenaproline-Se-75: a radiolabeled imino acid.** Wong, S.H.; Spencer, R.P.; Weaver, A. (Univ. of Connecticut, Farmington). pp 109-118 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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The radiolabeled imino acid Se-75-selenaproline was synthesized from Se-75-L-selenocystine. The imino acid was transported against a concentration gradient by intestinal sacs in vitro. Following intravenous administration in mice and rats, the ratio of radioactivity in brain was 4 to 5 fold higher with Se-75-selenaproline than with Se-75-L-selenocystine (but still less than the blood concentration). The compound shows some instability and has to be purified prior to use. Radiolabeled selenaproline may be of interest in following collagen synthesis up to 4-hydroxylation stage, and in examining amino acid/imino acid penetration across the blood/brain and other biological barriers.

5357 **Inorganic radiopharmaceuticals.** Deutsch, E. (Univ. of Cincinnati, OH). pp 129-146 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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The chemistries of gallium and technetium radiopharmaceuticals are discussed from the viewpoints of periodic relationships and the information to be gained via application of the techniques and methodologies of inorganic chemistry. Biodistribution of gallium radiopharmaceuticals appears to be determined by competetive equilibria, thermodyamically driven but possibly kinetically controlled. The chemistry of reduced technetium radiopharmaceuticals is complicated and subtle, but techniques such as single crystal x-ray structural analysis, electrochemistry, and high performance liquid chromatography, are being effectively used to elucidate this chemistry. Recent results from applications of these techniques are presented, emphasizing the growing synergism between inorganic chemistry and nuclear medicine.

5358 **Preparation of a new oxotechnetium-sulfur complex.** DePamphilis, B.V. (Harvard Medical School, Boston, MA); Jones, A.G.; Davis, M.A.; Davison, A. pp 155-162 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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The reduction of $^{99}TcO_4^-$ in the presence of 3,4-toluenedithiol by dithionite in aqueous alkali produces the oxotechnetium (V) bis-(3,4-toluenedithiolate) anion. This has been isolated as the tetrabutylammonium salt. The similarity of this anion to previously characterized square pyramidal oxotechnetiumbis-(1,2-dithiolates) has been established from elemental micro-analysis, infrared spectroscopy, and field desorption mass spectrometry.

5359 **Ion exchange methods for the determination of the net charge on some radiopharmaceuticals.** Owunwanne, A. (Univ. of Rochester, NY); O'Mara, R.E.; Blau, M.; Marinsky, J. pp 163-172 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The ion exchange distribution method was used to determine the charge on the radioactive species of ^{67}Ga citrate, $^{201}TlCl$, $^{169}YbDTPA$, /sup 99m/TcHEDP, /sup 99m/TcO_4^-, and the reactive /sup 99m/Tc species produced when pertechnetate is reduced by stannous ion. The charge on ^{67}Ga citrate was +1.5, indicating a polymerized species; the charge of $^{201}TlCl$ was confirmed to be +1; $^{169}YbDTPA$ and /sup 99m/TcO_4^- had charges of -2 and -1 respectively; /sup 99m/TcHEDP had a curve with changing slopes indicating charges of -2 and -0.5.

5360 **Microscale synthesis and biodistribution of Pt-195m-labeled cis-dichlorodiammineplatinum(II), cis-DDP.** Hoeschele, J.D.; Butler, T.A.; Roberts, J.A. (Oak Ridge National Lab., TN). pp 173-182 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Cis-DDP is a unique metal based antitumor drug which exhibits potent activity toward cancers of genitourinary origin. The major dose-limiting side-effect of cis-DDP is nephrotoxicity, which limits broader clinical use. We have initiated studies using Pt-195m-labeled cis-DDP to elucidate the critical pharmacological parameters affecting nephrotoxicity. The general details of the optimized microscale synthesis (50 μmole scale), the effects of varying the dose and concentration of cis-DDP, and the use of a diuretic on the biodistribution of Pt-195m-labeled cis-DDP are as follows: (1) yields of cis-DDP average 75%, (2) the product meets the well-defined purity criteria established for cis-DDP, (3) the % dose retained/gm tissue is independent of both dose and concentration (at a fixed dose) of cis-DDP, and (4) injection of the diuretic furosemide at 2 and 4 mg/kg leads to enhanced retention of Pt-195m in most organs at 24 hours. The potential clinical implications of these results are discussed.

5361 **Radiopharmaceuticals for neurological studies.** Welch, M.J.; Tewson, T.J. (Washington Univ., St. Louis, MO). pp 201-217 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Radiopharmaceuticals have been developed to measure several neurological parameters. These include, blood volume, brain tissue composition, blood flow, brain metabolism, brain receptor concentrations and the interactions of platelets with vessel walls. The production of specific radiopharmaceuticals to measure these functions is discussed, and some of the uses described. In general, these radiopharmaceuticals are labeled with short-lived positron emitting radionuclides although indium-111 can be used to label platelets to study platelet/vessel wall interactions.

5362 **Radioassay methods.** Ekins, R. (Middlesex Hospital Medical School, London, England). pp 219-240 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The general principle of radioassay and other related labelled reagent techniques are discussed. Theoretical and practical considerations indicate that assay methods relying on excess labelled antibody are likely to replace the current generation of competitive radioassay methods within the foreseeable future. It is in relation to the excess reagent techniques that labels other than radioisotopes are likely to provide increased sensitivity and speed and may replace isotopic techniques provided certain technological difficulties may be overcome.

5363 **Radionuclide lymphoscintigraphy: an update.** Ege, G.N.; Warbick-Cerone, A.; Bronskill, M.J. (Princess Margaret Hospital, Toronto, Ontario). pp 241-258 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Lymphoscintigraphy, utilizing the interstitial injection of radiocolloids of optimal physical and chemical properties, constitutes a safe, simple technique for visualizing lymph node groups inaccessible for study with radioconstrast lymphography. In a large group

of patients with breast carcinoma, the technique has provided a means for (a) accurate localization of parasternal nodes for optimum radiation therapy; (b) evaluating the status of the internal mammary nodes prior to arriving at a management decision; and (c) following patients to assess the response to therapy or progression of disease. Preliminary results obtained show good correlation with clinical stage and prognosis.

5364 **In-111 BLEDTA: a conjugate of bleomycin with a bifunctional chelating agent for tumor localization.** Goodwin, D.A. (Stanford Univ., Palo Alto, CA); Meares, C.F.; DeRiemer, L.H.; Diamanti, C.I.; Goode, R.L. pp 275-284 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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BLEDTA, a bleomycin A_2 analog containing an EDTA group was labeled in the EDTA group to a specific activity of 70 mCi/mg and used for animal and human studies. KHJJ mouse tumor uptake was higher than the orange Co-57 bleomycin isomer and the tumor/organ ratios were >1 for all organs except the kidney. In 29 biopsy proven cancer patients the scan done 24 hours post I.V. with 1-2 mCi of In-111 BLEDTA was positive in all clinically known sites in 18, and in some clinically known sites in 11. The In-111 BLEDTA clinical results are similar to reported Co-57 bleomycin clinical studies, and the method is proposed as an alternate way to produce a stable biologically active bleomycin labeled with In-111.

5365 **Compartmental studies of a mouse brain tumor.** Glenn, H.J.; Atallah, M.R.; Haynie, T.P.; Anderson, J.H.; Raulston, G.L. (Univ. of Texas System Cancer Center, Houston). pp 285-295 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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The purpose of this study was to determine the hematologic compartments, vascular, plasma, and extracellular fluid volumes of a brain tumor, normal brain, and other tissues in a well established mouse brain tumor model. Tumor vascular volume, determined using Cr-51 labeled red blood cells, was found to be 0.019 ml/g tumor over the first hour. Plasma volumes were estimated using I-131 labeled albumin. Only the 10-minute value (when corrected by the plasmacrit, 0.497) of 0.019 ml/g tumor agreed with the vascular volume. Extracellular fluid space, measured using ^{35}S sulfate, was found to be 0.51 ml/g tumor after an equilibration time of 6 hours. Relatively constant compartmental space values were obtained for other tissues except liver.

5366 **Development of a lymphscintigraphy agent: Tc-99m-Sn-PO_4.** Gilliland, D.L.; Basmadjian, G.P.; Kirschner, A.S.; Leonard, J.C.; Ice, R.D. (Univ. of Oklahoma, Oklahoma City). pp 321-330 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Stannous chloride dissolved in a solution of Na_2HO_4 pH 9.0 gives a stable solution of Sn(II) ions. When pertechnetate-99m is added to such a solution, a stable, soluble complex of technetium-99m-Sn-PO_4 results. This is a mixed metal complex in which the Tc is present in the $(III)^+$ oxidation state and the Sn is an integral part of the complex. This complex, when injected I.V., localizes in the RES due to the formation of an in-vivo colloid with Ca(II) ions in the blood. When injected subcutaneously (SC), the complex travels through the lymphatic channels and localizes in the lymph nodes. In rabbits, axillary and popliteal nodes were visualized after injecting SC into the dorsum of the hind and fore paws. In addition, uptake by the liver, kidneys and bone marrow was noted. After intratesticular injection in dogs, the para-aortic lymph nodes were imaged at 3 to 30 minutes.

5367 **Relative stability of In-111 and Ga-67 desferrioxamine and human transferrin complexes.** Weiner, R.E.; Thakur, M.L.; Goodman, M.; Hoffer, P.B. (Yale Univ., New Haven, CT). pp 331-340 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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The relative stabilities of Ga-67 and In-111 desferrioxamine B (DF) complexes in relation to human transferrin have been investigated by chromatographic and equilibrium dialysis techniques. The influence of pH, temperature and chelate concentrations have been studied of the formation of DF metal chelates. The Ga:DF complex is much stronger than the Ga:TF or the In:DF chelate. The results support the use of DF to reduce the Ga-67:TF radioactivity in vivo and suggest the possibility that siderophores (a class of DF-like compounds) may be responsible for the accumulation of Ga-67 in abscess.

5368 **Role of radiopharmaceuticals in nuclear hematology.** Thakur, M.L.; Gottschalk, A. (Yale Univ., New Haven, CT). pp 341-359 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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The continued reassessment and refinement of techniques during the past few decades have generated a series of radioactive agents that have been evaluated as tracers for cellular blood elements. A few of the radiopharmaceuticals which have contributed a great deal to nuclear hematology have been concluded in detail. The mode of their actions, merits and disadvantages have been discussed. None of te compounds currently available appear to meet all the ideal requirements in that it is still impossible to selectively label and follow a cohort of cells for their entire life span with external monitoring by currently available instrumentation. Nevertheless, the newer agents show great promise as potential radiopharmaceuticals designed to investigate a variety of hematologic disease in humans.

5369 **Noninvasive radioisotopic technique for detection of platelet deposition in coronary artery bypass grafts in dogs and its reduction with platelet-inhibitors.** Dewanjee, M.K.; Fuster, V.; Kaye, M.P.; Josa, M. (Mayo Clinic, Rochester, MN). pp 361-374 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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At 8 and 32 hours after saphenous vein bypass graft surgery in dogs, in vivo images (174 and 247 keV) were obtained with a gamma camera after I.V. injection, 2 hours postoperatively, of autologous Indium-111-labeled platelets (0.25 to 0.50 mCi) and Iodine-125-labeled fibrinogen (0.08 to 0.1 mCi). Under identical conditions, in dogs treated with dipyridamole (2.5 mg/kg/day) plus Aspirin (15 mg/kg/day), (D + ASA), the grafts and hemorrhagic cardiac muscle had significantly less platelet deposition as estimated by imaging. The radioactivity ratio of In-111 in isolated graft sections to nontarget tissues of blood, lung, and cardiac muscle in control and treated animals, sacrificed at 32 hours after administration, demonstrated a threefold reduction in platelet deposition in the bypass graft, and graft vs blood, lung, and myocardium ratios of 16.3 +- 10.8, 29.96 +- 25.6, 37.1 +- 29.4 were obtained in the control group of seven dogs. The corresponding values in the treated group of 12 dogs were 4.4 +- 3.2, 6.7 +- 5.5, 30.8 +- 28.1 respectively. On the other hand, fibrinogen uptake in the graft was not reduced by platelet-inhibitors and graft-to-blood, -lung, and -myocardium ratios of 10.5 +- 3.4, 21.9 +- 9.3, and 85.6 +- 34.9 respectively were obtained in both control and treated animals. This technique may be a promising tool for a better understanding of the role played by platelets and fibrinogen in the process of occlusion of saphenous vein bypass grafts and arteriosclerosis and its reduction with platelet-inhibitors.

5370 **In vitro study of the mechanism of the in vivo red blood cell labeling technique.** Billinghurst, M.W.; Somers, E.A. (Health Sciences Centre, Winnipeg, Manitoba). pp 375-383 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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This study shows that the labeling of red blood cells is primarily dependent on the stannous ion concentration with efficient labeling occurring when the stannous ion concentration is between 0.08 and 0.04 ugm per ml of blood. If the stannous ion concentra-

tion was below 0.04 ugm per ml the Tc-99m was found to be present in the plasma as free pertechnetate while at concentration over 0.08 ugm per ml the Tc-99m was increasingly present in the plasma as Tc-99m labeled compounds. Both pyrophosphate and stannous ions were shown not to associate with the red blood cells.

5371 **Studies on the accumulation of radiopharmaceuticals in injured tissues.** Robbins, E.B.; Chervu, L.R.; Blaufox, M.D. (Albert Einstein Coll. of Medicine, Bronx, NY). pp 385-393 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Localization of ^{67}Ga and /sup 99m/Tc-radiopharmaceuticals in various rat tissues was studied following diverse insults. The lack of specificity of radiopharmaceutical uptake in these injured tissues lends support to the probable importance of tissue injury and/or changes in blood vessel permeability in the localization of these agents. Studies of ^{67}Ga uptake in cultured cell monolayers as a function of temperature and in the presence of cytochalasin B indicate that the mechanism may involve both diffusion and pinocytosis.

5372 **Transport of /sup 99m/Tc complexes through the blood-brain barrier.** Loberg, M.D.; Corder, E.H.; Fields, A.T.; Callery, P.S. (Univ. of Maryland, Baltimore). pp 449-458 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Thirteen /sup 99m/Tc complexes have been synthesized and used to determine the relationships between protein binding, lipophilicity and membrane transport. The lipophilicity of the /sup 99m/Tc complexes was altered by adding substituents to either IDA, EDTA, DTPA or oxine; membrane transport was estimated using the brain uptake index (BUI) method. The BUI of the /sup 99m/Tc complexes was found to vary directly with lipophilicity and inversely with protein binding. These results demonstrated that /sup 99m/Tc-oxine derivatives are better suited for use in the development of intracellular tracers than are the /sup 99m/Tc derivatives of aminopolycarboxylates.

5373 **Radiopharmaceuticals in evaluation of kidneys.** Winchell, H.S. (Medi-Physics, Inc., Emeryville, CA). pp 459-463 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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The kidney may be thought of as a system which first filters low and medium molecular weight water-soluble materials from the blood and then either pumps or allows diffusion of such materials from the filtrate back into the blood after their passage through a chromatographic-like column contained within the renal tubules. Additionally, water-soluble materials in the blood may diffuse or be pumped in the opposite direction through the chromatographic column in the tubules to reach the filtrate. Materials whose renal handling is limited to filtration processes can be employed to measure glomerular filtration (e.g., radioinulin and possibly radiocations chelated by EDTA or DTPA). Materials whose renal handling is by a combination of filtration and quantitative pumping or diffusion from the blood to the filtrate, and for which retention in the chromatographic-like system of the tubules is negligible, can be employed for measuring renal plasma flow (e.g., radioiodohippurate). Materials which have prolonged retention times in the renal tubular chromatographic system can be used to evaluate renal anatomy and to infer aspects of renal physiology (e.g., Tc-99m DMSA).

5374 **Physiologic basis and utility of myocardial perfusion imaging.** Pohost, G.M.; McKusick, K.A.; Strauss, H.W. (Massachusetts General Hospital, Boston). pp 465-473 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Myocardial imaging with $^{201}Tl^{+}$ allows improved detection of coronary artery disease. The distribution of $^{201}Tl^{+}$ in heart muscle is related primarily to blood flow and cellular integrity. Serial imaging of $^{201}Tl^{+}$ heart muscle distribution demonstrates gradual fill in of initial $^{201}Tl^{+}$ defects which are due to ischemia (reduced blood flow and/or increased metabolic demand), and persistence of defects which are due to acute infarct or scar. Improvement in radionuclide detection or coronary artery disease will likely occur over the next decade through: (1) computer approaches to quantification of serial changes in $^{201}Tl^{+}$ distribution; (2) gamma camera tomographic approaches using multiaperture collimators; (3) addition of the multigated acquisition blood pool imaging approaches; (4) application of positron transverse section emission tomography; and (5) development of other radiopharmaceuticals.

5375 **Uptake of radiopharmaceuticals in developing myocardial lesions.** Kung, H.F.; Blau, M.; Ackerhalt, R. (State Univ. of New York, Buffalo). pp 475-485 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Isoproterenol induced myocardial damage in rats in a convenient model for the study of the varying uptake of radiopharmaceuticals during the course of infarct development. Using several known agents we have shown that the uptake in damaged rat hearts parallels what is known about the localization of these agents in human infarcts. The lesion to normal heart ratio is highest for MDP and PPi, with MDP having a higher ratio but a lower absolute uptake. GH and GA have much lower lesion to normal heart ratios but they are able to concentrate in infarcts at a much earlier stage of development. This model should be useful as a guide to the development of radiopharmaceuticals which localize during the early hours of human infarct development.

5376 **Improved preparation and application of Tc-99m-heparin for scintigraphic detection of experimental myocardial ischemic injury.** Kulkarni, P.V.; Parkey, R.W.; Buja, L.M.; Bonte, F.J.; Wilson, J.E. III; Willerson, J.T. (Univ. of Texas,, Dallas). pp 497-507 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Our previous studies demonstrated the localization of technetium-99m-labeled heparin in experimental myocardial infarction. In this report we describe a one-step method for preparation of the labeled agent and further evaluation of the agent in dogs undergoing temporary left anterior descending (LAD) coronary artery ligation for 45 minutes, 3 hours, and 6 hours. Moderate myocardial damage and uptake of technetium-99m-heparin (Tc-99m-heparin) occurred in one of five dogs after 45 minutes of temporary LAD occlusion. Maximum uptake of Tc-99m-heparin occurred after 3 hours of temporary coronary artery occlusion, and exceeded 20 times the activity in the normal myocardium in 4 of 6 dogs with hemorrhagic infarcts. Uptake of Tc-99m-heparin in damaged myocardium was somewhat lower after 60 hours of temporary LAD occlusion in the four dogs studied, but was still in the 15 to 1 range in three with hemorrhagic infarcts. In the animals with prominent histologic damage, there was scintigraphic detection of the damaged myocardium in vivo. These new data confirm that Tc-99m-labeled heparin is suitable for imaging damaged myocardium during early stages of ischemic injury if significant blood flow persists to the damaged myocardial area.

5377 **Potassium-38, a 7.6 minute half-lived radionuclide for assessment of myocardial function.** Chandra, R. (New York Univ., NY); McDonald, J.M.; Reiman, R.E.; Tilbury, R.S. pp 509-517 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Potassium-38 in isotonic saline solution has been used to study the effect of cardio-active drugs, dipyridamole, propanolol and digoxin on the potassium uptake in the myocardium of dogs. The ^{38}KCl without added carrier was injected intravenously at about 0, 1, 2, and 3 hours after administration of the drug and the dog was scanned with a rectilinear scanner from 10 to 25 minutes after injection. THe counts/sec/mCi corrected for decay were computed for a fixed number of scan elements and compared with

controls. Dipyridamole produced a 50 to 80% increase in potassium uptake at 1 hour which returned to normal at 3 hours, Digoxin produced a 10 to 30% increase, and propanolol produced a 25% decrease at 1 to 2 hours. Results are compared with studies of Hamilton using Tl-201. Our results demonstrate that measurements of K-38 uptake can be made at hourly intervals to study the effects of cardio-active drugs.

5378 **Review and current status of hepatobiliary imaging agents.** Loberg, M.D. (Univ. of Maryland Hospital, Baltimore); Porter, D.W.; Ryan, J.W. pp 519-543 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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This review will outline aspects of the normal hepatobiliary anatomy and physiology relevant to an understanding of cholescintigraphy and discuss factors of hepatobiliary diseases which impact on the design of new hepatobiliary radiopharmaceuticals. The synthesis, pharmacokinetics, and structure-distribution relationship of the existing /sup 99m/Tc hepatobiliary agents will be compared, and the clinical status of present cholescintigraphic agents will be summarized. Future trends in the design and use of hepatobiliary tracers will be presented.

5379 **Development and results of routine quality control procedures for Tc-99m iminodiacetate hepatobiliary agents.** Fritzberg, A.R.; Huckaby, D. (Univ. of Colorado, Denver). pp 545-553 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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A variety of solvent systems and adsorbent support systems were evaluated for use in the routine quality control of iminodiacetate radiopharmaceuticals. Using systems which gave R/sub f/ values between 0 and 1 preparation variables such as time and dilution were studied. Variability in the intensities of multiple peak patterns were found to not significantly alter the rate of biliary excretion as evaluated with Tc-99m-diethyl-IDA. The multiple forms coalesced into narrow single peaks when diluted in saline or in plasma suggesting rapid equilibration in vivo to common chemical forms.

5380 **In vivo kinetics of hepatobiliary agents in jaundiced animals.** Jansholt, A.L.; Vera, D.R.; Krohn, K.A.; Stadalnik, R.C. (Univ. of California, Sacramento). pp 555-564 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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Blood clearance, liver uptake and biliary and urinary excretion kinetics have been measured for I-131 rose bengal, Tc-99m PyG, and several Tc-99m-labeled iminodiacetic acid derivatives in normal rabbits and in rabbits infused with high doses of bilirubin. Serum bilirubin levels of up to 12 mg/dl resulted in some changes in the above parameters, including increased urinary excretion of Tc-99m PyG and delayed liver uptake and clearance of Tc-HIDA and rose bengal. However, the overall picture was one of the relatively small changes and poor quantitative correlation with the performance of these hepatobiliary radiopharmaceuticals in jaundiced patients. We conclude that as long as the hepatocytes are healthy, their capacity for excretion of organic anions is relatively insensitive to the amounts of bilirubin used in these experiments. The altered pharmacokinetics of these radiopharmaceuticals in jaundiced patients is thus largely related to impaired hepatocyte function.

5381 **Radioligands that bind to cell-specific receptors: hepatic binding protein ligands for hepatic scintigraphy.** Vera, D.R.; Krohn, K.A.; Stadalnik, R.C. (Univ. of California, Sacramento). pp 565-575 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

A conceptual model has been developed for designing and evaluating receptor - specific radiopharmaceuticals and maximizing their potential for scintigraphic evaluation of pathophysiology. Tracer ligands for receptors that serve a significant physiological role may be used to assess the functional state of the target cell. The criteria developed have been used to assess the potential of hepatic binding protein (HBP) ligands, a new class of radiopharmaceuticals based on the molecular biology of a hepatocyte membrane receptor. An analog ligand, technetium-99m-galactosyl neoglycoalbumin has the essential features of isotopic and biologic convenience; high ligand purity, stability and specificity; and the appropriate kinetics; to permit differentiation of the hemodynamic, receptor binding and molecular release phases of tracer kinetics.

5382 **Hepatobiliary transport mechanism of Tc-99m-N,α-(2,6-diethylacetanilide)-iminodicarboxylic acid (Tc-99m-diethyl-IDA).** Fritzberg, A.R.; Whitney, W.P.; Klingensmith, W.C. III. (Univ. of Colorado, Denver). pp 577-586 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

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The hepatobiliary transport mechanism of /sup 99m/Tc-N,α-(2,6-diethylacetanilide)-iminodiacetic acid (/sup 99m/Tc-diethyl-IDA) was studied by administering saturating doses of representatives of each of the defined transport pathways. The effects on the rate of biliary excretion were monitored by collection of bile from the common bile duct of rats. The administration of sulfobromophthalein decreased the rate of biliary excretion of both /sup 99m/Tc-diethyl-IDA and control ^{131}I-Rose Bengal. Taurocholate and procaine amide ethobromide increased the rate of biliary excretion. These results indicate that /sup 99m/Tc-diethyl-IDA is transported by the anion dye transport system of BSP and Rose Bengal.

5383 **Benzimidazolyl methyliminodiacetic acids: new bifunctional chelators of technetium for hepatobiliary scintigraphy.** Hunt, F.C.; Wilson, J.G.; Maddalena, D.J. (Australian Atomic Energy Commission, Lucas Heights). pp 587-592 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Dimethyl- and chloro- substituted benzimidazolyl methyliminodiacetic acids have been synthesized and evaluated as new bifunctional chelators of /sup 99m/Tc. Stannous chelates of these compounds were prepared as freeze-dried kits and labeled with /sup 99m/Tc. The radiopharmaceuticals thus prepared were rapidly excreted by the hepatobiliary system of rats and rabbits with little urinary excretion. The chloro- compound had a higher biliary and lesser urinary excretion than the dimethyl- however both technetium complexes provided good scintigraphic images of the hepatobiliary system in animals. The compounds behaved similarly to the /sup 99m/Tc-lidocaine iminodiacetic acid [HIDA] complexes with respect to their biliary elimination.

5384 **Biologic evaluation of radiocolloids for bone marrow scintigraphy.** Heyman, S.; Davis, M.A.; Shulkin, P.M.; Treves, S. (Harvard Medical School, Boston, MA). pp 593-601 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The validity of a primate animal model for studying the in vivo distribution of various colloids was established. Computerized images from two adult baboons injected with technetium-99m labeled sulfur colloid, stannous phytate and microaggregated albumin were analyzed to give the relative uptake of radioactivity in the liver, spleen and bone marrow. These values were in good agreement with those previously established in several animal species and in man. Antimony sulfide colloid and minimicroaggregated albumin, each having a significantly smaller particle size than Tc-99m sulfur colloid were evaluated. Compared with sulfur colloid the minimicroaggregated albumin showed three times the bone marrow uptake (15 to 20%) whereas microaggregated albumin and antimony sulfide gave somewhat lower values (8 to 12%). The stannous phytate showed no improvement over Tc-99m sulfur colloid (5 to 7%).

5385 Imaging the skeletal system. Francis, M.D.; Tofe, A.J.; Benedict, J.J.; Bevan, J.A. (Proctor and Gamble Co., Cincinnati, OH). pp 603-614 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The highly vascular system, inorganic calcium phosphates and a supporting fibrous matrix of the skeleton are considered with respect to skeletal imaging agents. The role and interrelations of the structure of the ligands complexing with reduced Tc-99m and their reaction with the organic and inorganic phases of bone are discussed. Two hydroxydiphosphonates (HEDP and HMDP) and a non-hydroxylated diphosphonate (MDP) were considered on the basis of their structure, calcium salt solubility, and clearance from the mammalian system. Based on specific adsorption properties for normal and active osteogenic bone, HMDP was found to be the most effective technetium complexing ligand.

5386 Improved model for Calcium-HEDP solution equilibria. Lamson, M.L.; Fox, J.L.; Higuchi, W.I. (Univ. of Michigan, Ann Arbor). pp 615-625 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Since hydroxyethylidene-1,1-diphosphonic acid has been reported to form polynuclear complexes with calcium ion, an investigation of the in vivo behavior of this bone agent should consider the equilibria of the Ca-HEDP species. This study employs TMAOH titration data and published formation curve data for nonlinear least squares parameter estimation based on a solution model which includes several polynuclear species. Fittings of both types of experimental data, and computer experiments varying sets of complexes and individual constants, predict that large polynuclear species may exist near neutral pH and that these species would have an extreme pH dependency in this region.

5387 Oxidation state of technetium in bone scanning agents. Russell, C.D.; Cash, A.G. (Veterans Administration and Univ. Medical Centers, Birmingham, AL). pp 627-635 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

We have identified the oxidation state of technetium by polarography after electrolytic reduction of pertechnetate in complexing media of pyrophosphate, methylene diphosphonate (MDP), and ethane-1, hydroxy-1 1-diphosphonate (EHDP). In the same media we have identified the oxidation state resulting from reduction with Sn(II) by means of amperometric titration. The stable states resulting from electrolytic reduction were found to be Tc(III) and Tc(IV) below pH 6, and Tc(IV) and Tc(V) above pH 10, for all three ligands. Between pH 6 and 10 the results depended on the ligand present. Tc(III) and Tc(IV) were identified in pyrophosphate and MDP, while EHDP Tc(II) and Tc(V) were identified with certainty, Tc(IV) questionably. Though two stable products thus resulted from electrolytic reduction at each pH, tin reduction gave only a single product, which was always Tc(IV) except in EHDP, where Tc(V) was formed in neutral or alkaline solution.

5388 Antioxidant stabilization of bone agents. Tofe, A.J.; Bevan, J.A.; Fawzi, M.B.; Whitehouse, H.S.; Francis, M.D. (Procter and Gamble Co., Cincinnati, OH). pp 637-644 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

In vitro instability associated with Tc-99m phosphonate skeletal imaging agents whose formulations contain a low tin(II) concentration is a direct result of the presence of oxidants. These contaminants are either radiolytically induced or introduced through chemical contamination. Stabilization has been demonstrated with ascorbic acid and in this paper, gentisic acid (2,5-dihydroxybenzoic acid) is shown to be an equally effective antioxidant for the (1-hydroxyethylidene) diphosphonate (HEDP) and hydroxymethylenediphosphonate (HMDP) skeletal imaging agents. In vitro studies in the presence of oxygen show less than 2% free [/sup 99m/Tc] sodium pertechnetate at 24 hours. Biodistribution studies in guinea pigs show no effect of the antioxidant upon the osseous specificity and suggest the sole function of gentisic acid is the interruption of radical chain propagated reactions.

5389 Tc-99m hydroxymethylene diphosphonate (HMDP): a new skeletal imaging agent. Bevan, J.A.; Tofe, A.J.; Francis, M.D.; Barnett, B.L.; Benedict, J.J. (Procter and Gamble Co., Cincinnati, OH). pp 645-654 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The hydroxymethylenediphosphonate ligand (HMDP) is a homolog of (1-hydroxyethylidene) diphosphonate (HEDP). Crystallographic studies with HEDP suggest the importance of the hydroxyl group in binding of the ligand to the growing surface of hydroxyapatite. Tc-99m HMDP has been investigated for use as a skeletal otential imaging agent. Animal biodistribution studies indicated excellent potential for skeletal and acute myocardial infarct imaging. In rats, femur/muscle uptake ratio averaged 638. In dogs, three hour whole blood retention averaged 1.3% of the dose, and the biodistribution of Tc-99m HMDP was significantly superior to that of Tc-99m MDP (methylenediphosphonate) and Tc-99m HEDP for skeletal imaging. In a dog myocardial infarct model, Tc-99m HMDP was shown to be equal to Tc-99m pyrophosphate for infarct imaging.

5390 Radiopharmaceuticals for thyroid imaging: a review. Nishiyama, H. (Univ. of Cincinnati, OH). pp 655-669 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

A review of radiopharmaceuticals which have been used for thyroid imaging was made with special emphasis on palpable thyroid nodules. An attempt was made to evaluate cold nodules derived from imaging methods using radioiodine or Tc-99m pertechnetate, followed by a successive application of another radiopharmaceutical. An attempt was also made to understand the pathophysiology of various thyroid disorders. The latter was based on the accumulated cases with discordant images between radioiodine and Tc-99m pertechnetate, and also on the iodine content within the gland by means of fluorescent techniques. Better radiopharmaceuticals are anxiously awaited in order to realize the distinction between benign and malignant thyroid disorders at the preoperative decision-making stage.

5391 Radiopharmaceuticals for pancreas, prostate and adrenal imaging. Blau, M.; Kung, H.F. (State Univ. of New York, Buffalo). pp 671-683 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

A large number of compounds have been investigated as possible agents for pancreas, prostate and adrenal imaging. These have been based on synthetic activity of the organs, organ control hormones, or drugs known to affect organ function. This effort has been only moderately successful. Clinically useful radiopharmaceuticals have been developed for pancreas (Se^{75}-L-selenomethionine) and for adrenals (I-131-6-iodomethylnorcholesterol) based on the synthesis of the digestive enzymes and the adrenal cortical steroid hormones, respectively. Neither of these meets the need for a low radiation dose, high photon flux, readily available agent. The record for the prostate is even more dismal. No clinically useful imaging compounds have been developed to date.

5392 Design of radiopharmaceuticals for adrenal imaging: effect of structure and metabolism on the distribution of H-3 and F-18 labeled pregnenolones. Spitznagle, L.A. (Univ. of Connecticut, Farmington); Eng, R.R.; Marino, C.A.; Trager, W.F. pp 685-696 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The kinetics of the tissue distribution of pregnenolone and pregnenolone-3-acetate labeled with ^{3}H and of 21-fluoropregnenolone and 21-fluoropregnenolone-3-acetate labeled with ^{3}H and with ^{18}F were studied in the rat. The maximum tissue concentration was 4.1 +- 0.5 %D/g in the adrenal glands, obtained 5 minutes after the administration of 21-fluoropregnenolone labeled with ^{18}F. The presence of th 3-acetate group reduced the maximum adrenal concentration to 2.4 +- 0.4 %D/g. The ratio of $^{18}F/^{3}H$ concentrations were high in the adrenal glands. The data indicate that the adrenal glands contain a high concentration of ^{18}F activity not associated with the steroid nucleus. Both ^{18}F-labeled pregnenolones are potentially useful radiopharmaceuticals for imaging the adrenal glands and/or measuring adrenal metabolism rates.

5393 **Synthesis and biological studies on an ^{125}I-analog of diazoxide.** Heindel, N.D.; Risch, V.R.; Burns, H.D.; Corley, E.G.; Michener, E.A.; Honda, T. (Hahnemann Medical Coll., Philadelphia, PA). pp 697-707 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

An ^{125}I-labeled diazoxide analog (7-iodo-3-methyl-2H-1,2,4-benzothiadiazine 1,1-dioxide) was synthesized and studied with respect to localization in a β-cell adenocarcinoma of the pancreas in hamsters. The iododiazoxide is stable in vivo and exhibits pharmacokinetic and excretion patterns similar to ^{3}H-diazoxide. Tumor to pancreas activity ratios demonstrated a progressive increase from 0.5 at 5 min to 3.8 at 6 hr. However, tumor to blood ratios never exceeded one at all time periods studied. The failure to achieve elevated tumor concentration of radioactivity may be due to the relatively low specific activity of the ^{125}I-iododiazoxide used in these studies.

5394 **Radiolabeled enzyme inhibitors as pancreatic scanning agents.** Mosley, S.T.; Kulkarni, P.V.; Parkey, R.W. (Univ. of Texas, Dallas). pp 709-716 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Radiolabeled inhibitors of the pancreatic protease enzymes trypsin and chymotrypsin: I-125-soybean inhibitor (SBI), I-125-human antitrypsin (HAT), and ^{3}H-diisopropylfluorophosphate (DFP) were studied in rats for their uptake in the pancreas. The protease enzyme inhibitor, SBI, was found to retain its enzymatic activity after radio-iodine labeling by iodine-monochloride method. Assay of tissues radioactivity at 5, 15, 30, 60 min and 24 hr after iv injection in rats showed pancreas:liver (P:L) ratios of $<$ 1.4 and pancreas:blood (P:B) ratios of $<$ 1 at all time intervals for each compound. However, ip injection of I-125 SBI showed preferential uptake in pancreas, P:L mean ratios [anti x (range)] of 6.0 (5.5 to 6.3) and P:B mean ratios of [anti x (range)] 2.60 (1.8 to 3.4), up to 60 minutes. These ratios resemble those of Se-75-selenomethionine except that kidney values are higher. Our data suggest that radiolabeled proteins can also show similar good early pancreatic uptake when given ip by escaping immediate liver metabolism. Proteins can readily be tagged with desirable gamma-emitting radionuclides (viz. I-131, I-123, Tc-99m) compared to amino acids and may potentially be suitable for imaging the pancreas. It may be important to study both iv and ip routes of administration in evaluating the specificity/affinity of potential pancreatic radiopharmaceuticals.

5395 **Radiobrominated androgens as potential prostatic imaging agents.** Counsell, R.E. (Univ. of Michigan, Ann Arbor); Klausmeier, W.H.; Castonguay, A.; Pozderac, R.V.; Weinhold, P.A.; Skinner, R.W.S. pp 717-725 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

A variety of analogs of testosterone were synthesized containing a bromine atom at different positions on the steroid nucleus. Analysis of these brominated androgens for their ability to compete with tritiated 5α-dihydrotestosterone in a rat prostate receptor protein assay revealed several brominated analogs to have an affinity in the order of testosterone. Of these analogs, 2-bromo-17β-hydroxy-5α-androst-1-en-3-one (I) was selected for further study. A synthetic route to this compound was devised that involved bromination in the presence of silver tetrafluoroborate as catalyst. Despite the stability of compound I under in vitro conditions, labeling with bromine-82 showed considerable debromination to occur in vivo. Such rapid debromination of radiobrominated steroids represents a serious constraint upon their potential use as radiodiagnostic agents.

5396 **Radionuclide production.** Silvester, D.J.; Waters, S.L. (Medical Research Council, London, England). pp 727-744 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The current programs of 51 accelerators (all but 2 of which are cyclotrons) producing radionuclides for medical use have been tabulated. With very few exceptions, notably ^{123}I and ^{201}Tl, only those radionuclides which are not available from the 9 commercial sources are made on the 42 non-commercial machines. Development of new radionuclides is mostly focused on short-lived positron emitters, or on generator systems, and some of the more innovative production methods are discussed. The cyclotrons now offered by the major manufacturers are reviewed in the light of present trends in radionuclide production and other influencing factors.

5397 **Cyclotron production of Thallium-201 via the $^{205}Tl(p,5n)^{201}Pb \rightarrow {}^{201}Tl$ reaction.** Lagunas-Solar, M.C.; Jungerman, J.A.; Paulson, D.W. (Univ. of California, Davis). pp 779-789 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The production of the clinically useful ^{201}Tl radioisotope was investigated based upon the utilization of the $^{205}Tl(p,5n)^{201}Pb \rightarrow {}^{201}Tl$ reaction. Thin-stacked metallic foils of 99.5% enriched ^{205}Tl were used as targets. Thick-target yields for the daughters ^{201}Tl, ^{200}Tl, and ^{202}Tl were calculated as a function of target thickness, bombarding time, target chemistry time, and incident proton energies. The results demonstrated the feasibility of utilizing the (p,5n) reaction to produce ^{201}Tl of similar radionuclidic composition and in yields comparable to the $^{203}Tl(p,3n)^{201}Pb \rightarrow {}^{201}Tl$ method.

5398 **Development of a chromatographic Ge-68-Ga-68 generator yielding ionic gallium.** Neirinckx, R.D.; Davis, M.A. (Harvard Medical School, Boston, MA). pp 791-799 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The behavior of germanium and gallium on various organic chromatographic supports was investigated. The aim was to develop a simple high-yield chromatographic system for the routine production of ionic Ga-68 from a Ge-68-Ga-68 generator. The most attractive systems developed are based on adsorption of Ge-68 on an anion-exchange resin (Bio-Rad AG1-X8) or on a new synthetic resin, developed in this laboratory specifically for adsorption of germanium. The generator based on AG1-X8 with 0.01N HF as the eluent yields 95% of the Ga-68 in a 3 ml volume. Up to 600 elutions were performed before Ge-68 breakthrough reached 10^{-2}%. The synthetic resin yielded more than 60% of available Ga-68 in 5 ml of 0.3N HCl. More than 600 collections were performed from the same generator with Ge-68 breakthrough levels of less than 10^{-3}%.

5507 Microbiology

REFER ALSO TO CITATION(S) 5025, 5332, 5334, 5401, 5436

5399 **Siderophore-mediated mechanism of gallium uptake demonstrated in the microorganism Ustilago sphaerogena.** Emery, T. (Utah State Univ., Logan); Hoffer, P.B. Contract EP-78-C-02-4625. *USJournal of Nuclear Medicine (U.S.);* **21**: No. 10, 935-939(Oct 1980).

From 28. annual meeting of the Society of Nuclear Medicine; Las Vegas, NV, USA (16 Jun 1981).

The radioactive gallium analog of ferrichrome, Ga-67 deferriferrichrome, has been prepared and compared with ferrichrome in the specific siderophore-transport system of Ustilago sphaerogena. The gallium analog is taken up by the cells in an active transport process indistinguishable from that of ferrichrome. The findings may explain how Ga(III) mimics Fe(III) in clinical use.

5400 **Non-aerated cultivation of Halobacterium cutirubrum and its effect on cellular squalenes.** Tornabene, T.G. (Colorado State Univ., Fort Collins). *USJournal of Molecular Evolution (U. S.);* **11**: 253-257(1978).

Halobacterium cutirubrum was successfully cultivated under aerobic and microaerobic conditions. The early stationary phase of growth was obtained at 2.2 days and 45 to 55 days for aerated and non-aerated cultures, respectively. The dry cell yields were 0.7 to 1.2 gm/l in all preparations grown to early stationary growth phase. The cellular ratio of squalene to dihydro- and tetra-hydrosqualene decreased proportionately with decreased aeration rates.

5509 Pathology

REFER ALSO TO CITATION(S) 5365, 5375

5401 **(DOE/EV/00965—3) Study of red-sore disease in alligators. Final report, September 1, 1976-September 3, 1980.** Gorden, R.E.; Esch, G.W. (Wake Forest Univ., Winston-Salem, NC (USA). Dept. of Biology). 1980. Contract AS09-76EV00965. 27p. NTIS, PC A03/MF A01.

Necropsies of eight alligators which died following capture within a thermally-altered reservoir demonstrated the presence of the gram negative, pathogenic bacterium Aeromonas hydrophila, in internal tissues. A study designed to demonstrate whether A. hydrophila were capable of causing infection and death of the ecologically threatened alligator and, if so, the mechanism of exposure and infection in natural habitats was undertaken. The pathology and response to infection were also studied. When juvenile alligators were exposed under experimental conditions to increasing concentrations of A. hydrophila in water, by oral inoculation, or by intramuscular injections at 20°, 25°, 30°, and 35°C, they developed external lesions. These lesions were likely to become severe and lead to death of the animal at 30 and 35°C. Infected animals produced: (a) increased numbers of white blood cells; (b) increased specific antibody titer; and (c) alpha 2 peaks higher than albumen peaks (except at 35°C). Biweekly intraperitoneal injections of live, washed A. hydrophila were apparently more effective in the prevention of infection and of external lesions than were the antibiotics Kanamycin and OTH-Puramycin. Topical applications of Neosporin ointment resulted in the healing of severe lesions on confined animals. Alligators which were shown to be exposed to A. hydrophila in their natural habitats showed no external evidence of infection by the bacteria. It is recommended that exposure to conditions of stress, including water temperatures greater than 30°C, be kept to a minimum during the capture, transport, and captivity of alligators. (ERB)

5510 Physiological Systems

5402 **(PB—80-175912) Bone calcium determination in vivo by proton activation analysis. Doctoral thesis.** Eilbert, R.F. (Harvard Univ., Cambridge, MA (USA). Dept. of Physics). May 1975. 241p. NTIS PC MF A01.

A method is presented for in vivo calcium measurement developed at the 160 MeV cyclotron at Harvard University. Advantages of the technique include direct measurement of calcium in the lumbar vertebrae and restriction of dose to the immediate vertebral region. The technique may be used in plotting serial changes of a patient's calcium level in response to treatment. Proton activation of 40Ca(97% abundant) in bone produces 38K which undergoes beta decay, emitting a 2.17 MeV gamma ray with a half life of 7.71 minutes. Knowledge of the proton flux and efficient detection of the subsequent gamma radiation allows a precise determination of calcium in vivo. Precision is mainly limited by counting statistics; a two rad dose over three or four vertebrae ensures measurement reproducibility to within 4%. The report describes certain major problems that were encountered and attempts made to eliminate them. Also presented are studies with phantoms to establish the technique's sensitivity, reproducibility and linearity of response in calcium content and in integral dose. Appendices include computer programs for decay curve analysis and for designing the range modulator.

5403 **Chemical mediators of granulopoiesis: a review.** Brennan, J.K.; Lichtman, M.A.; DiPersio, J.F.; Abboud, C.N. (Univ. of Rochester, NY). *DKExperimental Hematology (Denmark)Formerly EXHEB;* **8**: No. 4, 441-464(Apr 1980).

Advances in the culture of primitive hemopoietic cells have added to our understanding of granulopoiesis. Granulocyte production appears to be under both stimulatory and inhibitory control. Colony stimulating factor (CSF), a group of glycoproteins, are specific stimulants of granulocyte and monocyte progenitor cells and may be analogous to erythropoietin. The inhibitory control of granulopoiesis is less well established than the stimulatory. The most promising candidate for a negative feedback mediator is colony inhibiting activity (CIA), a glycoprotein similar to, if not identical with, lactoferrin. This molecule appears to act by reducing colony stimulating facor production by monocytes. Prostaglandins of the E-type and other low molecular weight inhibitors of granulopoiesis have been described but do not appear to be specific for granulocytic cells. At present, there is no decisive evidence that CSF or other granulocyte modulating substances in vitro are in vivo regulators.

5404 **Founding and early history of the American association for laboratory animal science.** Flynn, R.J. (Argonne National Lab., IL). *USLaboratory Animal Science (U.S.)Supersedes Lab. Anim. Care;* 765-779(1980).

The author presents an historic overview of the organization of the American Association for Laboratory Animal Science beginning in Chicago in 1945. The programs and pictures of the sites of the first six meetings, through 1955, are included. (KRM)

5405 **Fate of blood granulocytes.** Jamuar, M.P.; Cronkite, E.P. (Brookhaven National Lab., Upton, NY). *DKExperimental Hematology (Denmark)Formerly EXHEB;* **8**: No. 7, 884-894(1980).

The present study was undertaken to determine whether neutrophilic granulocytes leave the vascular bed and enter body tissues, particularly the lung, in pathogenfree mice under normal steady state conditions and also under inflammatory stress. Tissues from normal mice and from mice with granulocytosis-producing tumor were processed fo electron microscopic studies. Emigration of neutrophils outside the capillaries was observed under inflammatory conditions. Granulocytes were also observed to be concentrated for destruction of the spleen, perhaps the major site for removal of granulocytes. In the pathogen-free mice granulocytes did not appear to leave blood vessels and enter tissues.

5406 **Corneal-shaping electrode.** Doss, J.D.; Hutson, R.L. (to Dept. of Energy). US Patent Application 100,664. 5 Dec 1979. 14p.

The invention relates to corneal reshaping and more particularly to electrodes utilizing radiofrequency electrical current to heat and thereby induce reshaping of the cornea in humans and animals.

5520 Public Health

5407 **Regulation of radiopharmaceuticals: an analysis of radiopharmaceuticals approved for marketing in the United States, 1951-1978.** Halperin, J.A.; Stringer, S.A.; Eastep, R.D. (Food and Drug Administration, Rockville, MD). pp xxi-xxxiv of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Regulation of radioactive drugs has evolved from a system of control outside the new drug provisions to where they are fully integrated into FDA's new drug evaluation process. Radiopharmaceuticals are now subject to the new drug classification system and, through use of that system, the percentages of new

radioactive molecular entities and important therapeutic gains are noted to be lower than the percentages of new molecular entities and important gains for non-radioactive drugs. Finally, the average time for approval of radiopharmaceuticals is longer than for non-radioactive drugs, although the time for recently developed radiopharmaceuticals is less than the mean for all NDA's. Innovative strength in radiopharmaceutical development is strong as a number of new radionuclide-tagged carrier molecule combinations are either pending approval or in clinical trials.

5408 **Regulatory control of radiopharmaceuticals in Canada.** Letourneau, E.G.; Welsh, W.J. (Radiation Protection Bureau, Ottawa, Ontario). pp xxxv-xli of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The Radiation Protection Bureau of the Department of National Health and is responsible for the regulatory control in Canada of radiopharmaceuticals, generators, and cold kits for the preparation of radiopharmaceuticals. A manufacturer must possess a Food and Drug license before offering his products for sale and, if applicable, be in compliance with the new drug regulations. Continuing control is maintained through periodic plant inspections, a quality assessment program of licensed products, and Welfare in some instances by promulgation of regulations.

5409 **Quality control analysis at the hospital.** Kristensen, K. (National Health Service of Denmark, Copenhagen). pp 1-14 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Quality control analysis is an integral part of quality assurance. In a system as with radiopharmaceuticals where part of the finishing of the product takes place at individual hospitals, the need for quality control analysis at the hospital can be discussed. Data are presented that stresses the importance of quality control by the manufacturer as a basis for limitation of such work at hospitals. A simplified programme is proposed.

5530 Agriculture And Food Technology

5410 **Nitrogen-fixing species in short rotation systems for fiber and energy production.** Zavitkovski, J.; Hansen, E.A.; McNeel, H.A. (North Central Forest Experiment Station, Rhinelander, WI). pp 388-402 of Symbiotic nitrogen fixation in the management of temperate forests. Gordon, J.C.; Wheeler, C.T.; Perry, D.A. (eds.). Corvallis, OR; Oregon State University (1979).

Three aspects of N-fixing species in short rotation systems were assessed: (1) production and potential utilization of biomass of natural red alder stands; (2) effects of N-fixing trees on growth of some rapidly growing non-N-fixing trees in mixed plantations; and (3) use of herbaceous legumes as nurse crops. Stem-branch biomass production of 7- to 15-year-old natural red alder stands on the Pacific Coast ranged from 10 to 15 mt/ha/year. The energy content ranged from 170 to 260 million Btu/ha/year, which is equivalent to 30 to 45 barrels of oil/ha/year. Soil N accretion rates under N-fixing trees ranges from 30 to 300 kg/ha/yr. Growth of companion species is accelerated when grown in association with N-fixing trees. Used as nurse crops, various herbaceous legumes benefit concurrently planted hybrid poplars and other species. The legumes enrich the soil with nitrogen, suppress weeds, and stimulate growth of the target species.

5411 **Identification of oleoresin in epoxy-embedded slash pine tissue.** Birchem, R.; Brown, C.L. (Univ. of Georgia, Athens). **53**: No. 2, 67-72(1978).

Sudan black B stains oleoresin blue-black in epoxy-embedded material as well as in living tissue. The Sudan black B staining properties of oleoresin are similar to those of lipid, but it can be distinguished from tannin, which stains brown. Practically all oleoresin present in resin ducts and intercellular spaces, and much of that contained in epithelial and ray cells, is extracted in preparatory procedures for electron microscopy. A fixation procedure is proposed which preserves significantly more oleoresin in situ. The use of Sudan black B enables one to localize oleoresin by light microscopy, and permits direct comparison of adjacent sections of epoxy-embedded material at the ultrastructure level. Ultrastructurally oleoresin and lipid possess similar electron densities and can be distinguished from the highly electron-opaque tannin deposits.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5412 **(BNL—28402) Biodistribution of Ru-97-labeled DTPA, DMSA and transferrin.** Som, P.; Oster, Z.H.; Fairchild, R.G.; Atkins, H.L.; Brill, A.B.; Gil, M.C.; Srivastava, S.C.; Meinken, G.E.; Goldman, A.G.; Richards, P. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA)). 1980. Contract AC02-76CH00016. 20p. (CONF-801082—4). NTIS, PC A02/MF A01.

From ORAU radiopharmaceutical dosimetry symposium; Oak Ridge, TN, USA (6 Oct 1980).

Ruthenium-97 is being produced at the Brookhaven Linac Isotope Producer (BLIP). The favorable physical properties of Ru-97 and chemical reactivity of ruthenium offer a potential for using this isotope to label compounds useful for delayed scanning. Diethylenetriamine pentaacetic acid (DTPA), 2,3-Dimercaptosuccinic acid (DMSA), and Transferrin (TF) were labeled with Ru-97-chloride. Ru-97-DTPA and In-111-DTPA, injected intravenously, showed similar organ distribution, kinetics, and more than 80% excretion by 0.5 h. Ru-97-DTPA and In-111-DTPA injected into the cisterna magna of dogs showed similar kinetics in brain, blood, and urinary bladder. The energy deposited by 1 mCi In-111-DTPA is twice that from 1 mCi Ru-97-DTPA. High quality camera images of the CSF space in the dog were obtained with both isotopes. Ru-97-DMSA was prepared with and without the addition of $SnCl_2.2H_2O$. Tin-free DMSA was rapidly excreted via the kidneys, whereas for maximum cortical deposition, the tin-containing preparation was superior. This compound is suitable for delayed imaging of both normal and impaired kidneys. Tissue distribution studies were performed in abscess-bearing rats with Ru-97-transferrin. Although blood levels were higher than with Ga-67-citrate, the abscess had twice as much Ru-97-TF as Ga-67-citrate and the Ru-97 muscle activity was one-third that of Ga-67. Imaging of abscess-bearing rabbits with Ru-97-TF visualized the abscesses as early as 1/2 hr after injection. Since the initial images visualize the abscess so clearly and since the TF portion of the compound binds to the abscess, Tc-99m-TF is being studied for the same purpose. Ru-97-labeled compounds are a promising replacement for In-111 and possibly also for Ga-67 compounds with the advantages of lower radiation dose and high quality image. (ERB)

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5413 (COO—4733-2, pp 158-161) **Associated ion experiment.** Bird, R.P. Jul 1979.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1978-September 30, 1979.

Diatomic deuterium ions were used as a source of correlated pairs of ions at RARAF in studies of the dependence on their separation for mammalian cell killing. However, the separations that could be attained, while holding constant the LET of the particles, are limited by the available RARAF energy. The RARAF acceleration voltage is adjusted so that the LET of the particles, as they subsequently traverse mammalian cells, is the same for each Mylar thickness. In order to extend the studies to greater separations, a change was made to diatomic hydrogen ions as the source of correlated pairs of ions. The characteristic separations that result when diatomic hydrogen ions traverse different Mylar thicknesses are tabulated. For comparison, the characteristic separation is approximately the same for paired deuterons traversing 10 μm Mylar plus a 3 μm cell thickness as it is for paired protons traversing 6 μm Mylar plus a 3 μm cell thickness.

5414 (COO—4733-3) **Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.** Rossi, H.H.; Hall, E.J. (Columbia Univ., New York (USA). Radiological Research Lab.). Jul 1980. Contract AS02-78EV04733. 350p. NTIS, PC A15/MF A01.

Separate abstracts were prepared for 31 of the 32 papers presented in this progress report. The other paper is represented by an abstract only and deals with field shaping and recalibration of x-ray facilities.

5415 (COO—4733-3, pp 14-22) **Dosimetry and source design for measurement of the relative biological effectiveness of photons from ^{125}I.** Goldhagen, P. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

This laboratory is beginning low dose rate studies of the effects of ^{125}I photons on mammalian cells by comparing the effectiveness of the radiation with that of ^{137}Cs gamma rays in reducing the reproductive viability of exponentially growing cells. There are a number of special problems associated with the dosimety. These arise from the low activity of available ^{125}I sources together with the range of dose rates required and from the low energy ^{125}I photons. A special ionization chamber, designed within the restrictions imposed by these problems, has been built and tested.

5416 (COO—4733-3, pp 135-142) **Sequential exposures to mixed fields of radiation. A theoretical approach.** Zaider, M.; Rossi, H.H. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

The Theory of Dual Radiation Action (TDRA) is described in relation to mammalian cells exposed sequentially to mixed fields of radiation. A theoretical description is presented along with experimental and calculated survival curves for sequential exposure of Chinese hamster V79 cells with deuterons and/or x-rays.

5417 (COO—4733-3, pp 147-154) **Oncogenic transformation of mouse C3H/10T1/2 cells exposed to 300 kVp x-rays or 35 MeV neutrons.** Miller, R.C.; Hall, E.J.; Shapiro, P. (Naval Research Lab., Washington, DC). Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

The C3H/10T1/2 cl 8 mouse fibroblast cells exhibit good contact inhibition and cease cell division at confluency. Cells were exposed to neutrons with an average energy of 15 MeV from the Naval Research Laboratory, Washington, D.C. Relative biological effectiveness (RBE) for transformation induction and cell killing between neutrons and 300 kVp x-rays were examined in this study. In addition, the effects of exposing cells to single or two doses of neutron split by 5 hours were determined.

5418 (COO—4733-3, pp 166-187) **Retinoids and a tumor promoter modify radiation induced transformation but not sister chromatid exchanges in rodent cells.** Miller, R.C.; Geard, C.R.; Osmak, R.S.; Rutledge-Freeman, M.; Borek, C. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

This report examines the antagonism that has been suggested to exist between retinoids and tumor promoters on oncogenic transformations of C3N/10T1/2 Cl. 8 cells and hamster embryo cells. The patterns of DNA damage using sister chromatid exchange analysis were examined. Results indicated that retinoids not only reduce the frequency of in vitro transformation induced by ionizing radiation, but also completely eliminate the promotional effects of TPA.

5419 (COO—4733-3, pp 188-196) **X-ray-induced in vitro neoplastic transformation of human diploid cells.** Borek, C. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

Techniques have recently been developed to identify and score quantitatively neoplastic transformation caused by x-rays in cultured cells derived from rodents. The present report describes for the first time the neoplastic transformation in vitro of human diploid cells by x-ray irradiation into cells which can progress in vitro into advanced stages of neoplastic development, namely, to form colonies in agar and give rise to tumors when injected into nude mice.

5420 (COO—4733-3, pp 209-212) **Oxygen enhancement ratio for high energy neutrons.** Hall, E.J.; Astor, M. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1979-September 30, 1980.

There have been reports in the literature that neutron energies higher than those currently in use may result in a lower OER; reports of experiments at the University of Maryland cyclotron indicated OER values of 1.3 and 1.2 for neutrons generated by 80 MeV deuterons and 101 MeV protons beryllium respectively. Because of the practical importance of this subject, the present communication reports the results of experiments with the 101 MeV and proton beam also with a beam generated by 80 MeV deuterons on a thin combination target of beryllium and tantalum. The results of this series of experiments are in direct conflict with the published data. We see no indication of a reduced OER for higher neutron energies.

5421 (COO—4733-3, pp 213-220) **Hypoxia mediated drugs as radiosensitizers and cytotoxic agents.** Hall, E.J.; Astor, M.; Alonso, B.; Abrams, S. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1979-September 30, 1980.

The identification and synthesis of alternative compounds, which equal misonidazole in radiosensitizing efficiency, while at the same time exhibiting less troublesome side-effects are the subjects of this report. Two of the most promising contenders are desmethylmisonidazole and SR 2508. Experiments with cells cultured in vitro were designed to compare the properties of misonidazole with these two potential replacements.

5422 (COO—4733-3, pp 243-256) **Sensitivity to x-rays and uv of cis platinum (II) sensitive V-79 cells.** Freeman, M.L. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

A striking aspect of the chemotherapeutic drug cis platinum (II) diamminedichloride (cis Pt II) is that its cytotoxicity varies considerably among different mammalian cell lines. In order to gain a better understanding of the parameters which influence cis platinum induced cytotoxicity, an attempt was made to isolate a cell strain sensitive to cis Pt (II). The experiments described here demonstrate that a stable cell line V-79-2, isolated from V-79 cells which had survived a pretreatment with cis Pt (II) exhibited a greater susceptibility to cis Pt (II) induced damage when compared to the parental line. Yet both lines had the same doubling time and sensitivity to x or uv irradiation.

5423 (COO—4733-3, pp 257-270) **Evaluating the interaction of protease inhibitors with DNA in human cells.** Borek, C. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

DNA damage and repair in human fibroblasts were investigated by a variety of standard techniques to ascertain whether antipain a protease inhibitor, has a discernible, direct effect on DNA. Antipain was also incubated with rat-liver microsomal S9 mix to determine whether it could be activated by mechanisms often observed with carcinogens. It was hoped that these experiments would aid in determining the mechanism of antipain in modifying cell transformation and the existence in mammalian cells of mechanisms analogous to the prokaryotic recA inducible system.

5424 (COO—4733-3, pp 295-305) **Antipain and radiation effects on oncogenic transformation and sister chromatid exchanges in syrian hamster embryo and mouse C3H 10T1/2 cells.** Geard, C.R.; Rutledge-Freeman, M.; Miller, R.C.; Borek, C. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

This study was designed to address the question of whether the temporal modification of induced transformation response by

antipain was paralleled by induced changes in sister chromatid exchange frequencies, a monitor of DNA interchange activity. S.C.E.'s have been shown to be sensitive indicators of mutagen-carcinogens and to have considerable utility as monitors of such compounds.

5425 (COO—4733-3, pp 306-313) **Interaction of high- and low-LET sublethal damage: effect on the reproductive capacity of cultured human cells.** Furcinitti, P.S. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

The unique track segment and x-ray irradiation facilities available at RARAF provide an ideal opportunity to investigate the effects of high- and low-LET radiations delivered to cells with short time intervals between doses. In initial experiments to investigate the discrepancy between the response of rodent and human cells in vitro to mixed modality irradiation, cultured human kidney T-1 cells were exposed to ^{3}He ions of well-defined LET (70, 90, or 140 keV/micron) followed five minutes later by graded doses of 50 kV x rays.

5426 (COO—4733-3, pp 314-323) **Relative biological effectiveness of photons from ^{125}I at low dose rates.** Goldhagen, P.; Freeman, M.; Hall, E.J. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

This laboratory is beginning low dose-rate studies of the radiobiology of ^{125}I photons by comparing their effectiveness in producing reproductive death and mitotic delay in Chinese hamster ovary (CHO) cells in vitro with that of ^{137}Cs gamma rays. Work during the past year has concentrated on dosimetry and on development of facilities to simultaneously provide conditions suitable for cell growth and clinical-range dose rates from ^{125}I or ^{137}Cs.

5427 (COO—4733-3, pp 324-332) **Sequential exposures with high- and low-LET radiations.** Bird, R.P. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

Experiments were done using the RARAF track segment facility in which synchronized cells were irradiated with high-LET charged particles and then, within a few minutes, were exposed to graded doses of x rays. The intent of these experiments is to evaluate the interaction of damage produced by radiations of different quality.

5428 (COO—4733-3, pp 333-338) **Associated ion experiment: the effect of proton triads on cell survival.** Bird, R.P. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

The experiments with correlated ions were conducted at RARAF using synchronized Chinese hamster V79 cells. Previous experiments measured the cell killing effectiveness of single- and multiple-ions using diatomic deuterium or diatomic hydrogen as the source of associated ions. Triatomic hydrogen was used in the present experiments.

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5429 (NUREG/CR—1194) **Transportation of radioactive material in Michigan. Report for 1 Sep 78-31 Aug 79.** (Michigan Dept. of Public Health, Lansing (USA). Div. of Radiological Health). Apr 1980. Contract NRC-06-77-051. 79p. NTIS, PC A05/MF A01.

This report describes a one-year study conducted by the State of Michigan on the transportation of radioactive material into, within, and through the State of Michigan from September 1, 1978 to August 31, 1979. The data collected during the monitoring process are contained in this report. The data relate to personnel radiation exposures, condition of packages, handling practices, and general adherence to regulations governing the safe transport of radioactive materials.

5430 (NUREG/CR—1304) **Performance testing of personnel dosimetry services. Supplementary report, Oct 77-31 Dec 79.** Plato, P.; Hudson, G. (Michigan Univ., Ann Arbor (USA). School of Public Health). Apr 1980. Contract NRC-01-77-180. 113p. NTIS, PC A06/MF A01.

The University of Michigan conducted a two-year pilot study of the Health Physics Society Standards Committee (HPSSC) Standard, 'Criteria for Testing Personnel Dosimetry Performance.' After the pilot study was concluded on September 27, 1979, the HPSSC Standard was revised based, in part, on experiences and recommendations derived from the pilot study. The Nuclear Regulatory Commission extended the contract under which the pilot study was conducted primarily so the data produced during the pilot study could be examined using the revised HPSSC Standard. The results of this extension to the pilot study show that the passing rate increases substantially when the revised version of the Standard is used instead of the original version. Data are also given that show the percent of dosimeters used in the United States that are being processed by processors that passed the revised version of the HPSSC Standard. Finally, data are given that show that the production of bremsstrahlung is negligible for the strontium-90 source used during the pilot study, but that a processor that uses a deep depth considerably less than 1000 mg/sq. cm. will over-estimate deep doses for beta-plus-gamma irradiations.

5431 (ORNL—5649) **Estimates of dose due to noble gas releases from the Three Mile Island incident using the AIRDOS-EPA computer code.** Cotter, S.J.; Miller, C.W.; Moore, R.E.; Little, C.A. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 57p. NTIS, PC A04/MF A01.

In response to a request from the Task Group on Health Physics and Dosimetry of the President's Commission on the Accident at Three Mile Island (TMI), radiation doses to persons living within 80 km were estimated using the AIRDOS-EPA computer code. Hourly radionuclide release and corresponding meteorological data were supplied by the Task Group. From these data the degree of dispersion of the total release into each of 16 wind direction sectors was calculated. The average fractions of the total release of the noble gases ^{133}Xe, ^{135}Xe, and ^{88}Kr (the major dose contributors) were estimated to be 95%, 4%, and 1%, repsectively. The release period used in our calculations was from March 28 through April 15, 1979 (19 days). The highest population dose estimate for the TMI incident is about 1% of that expected annually from natural background for the same population (2700 person-Sv). It has been estimated that this dose is too small to result in any detectable physical health impact.

5432 (ORNL/TM—7105) **Combined methodology for estimating dose rates and health effects from exposure to radioactive pollutants.** Dunning, D.E. Jr.; Leggett, R.W.; Yalcintas, M.G. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 96p. NTIS, PC A05/MF A01.

The work described in the report is basically a synthesis of two previously existing computer codes: INREM II, developed at the Oak Ridge National Laboratory (ORNL); and CAIRD, developed by the Environmental Protection Agency (EPA). The INREM II code uses contemporary dosimetric methods to estimate doses to specified reference organs due to inhalation or ingestion of a radionuclide. The CAIRD code employs actuarial life tables to account for competing risks in estimating numbers of health effects resulting from exposure of a cohort to some incremental risk. The combined computer code, referred to as RADRISK, estimates numbers of health effects in a hypothetical cohort of 100,000 persons due to continuous lifetime inhalation or ingestion of a radionuclide. Also briefly discussed in this report is a method of estimating numbers of health effects in a hypothetical cohort due to continuous lifetime exposure to external radiation. This method employs the CAIRD methodology together with dose conversion factors generated by the computer code DOSFACTER, developed at ORNL; these dose conversion factors are used to estimate dose rates to persons due to radionuclides in the air or on the ground surface. The combination of the life table and dosimetric guidelines for the release of radioactive pollutants to the atmosphere, as required by the Clean Air Act Amendments of 1977.

5433 Imaging of the human heart after administration of l-(N-13)glutamate. Gelbard, A.S.; Benua, R.S.; Reiman, R.E.; McDonald, J.M.; Vomero, J.J.; Laughlin, J.S. (Memorial Sloan-Kettering Cancer Center, New York). Contract EE-77-S-4268. *USJournal of Nuclear Medicine (U.S.);* **21**: No. 10, 988-991(Oct 1980).

From 28. annual meeting of the Society of Nuclear Medicine; Las Vegas, NV, USA (16 Jun 1981).

In normal volunteers and cancer patients, studies using L-(N-13)glutamate as an imaging agent showed localization of N-13 activity in the heart. Other organs that were well visualized include the liver, pancreas, and salivary glands. The concentration of N-13 activity in the human heart could not be predicted from previous studies involving myocardial uptake in dogs and rodents after administration of L-(N-13)glutamate.

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5434 Biophysical studies with spatially correlated ions. IV. Analysis of cell survival data for diatomic deuterium. Kellerer, A.M. (Wuerzburg Univ., Germany); Lam, Y.M.P.; Rossi, H.H. Contract AS02-78EV04733. *USRadiation Research (U.S.);* **83**: No. 3, 511-528(Sep 1980).

An analysis is given of previously reported results of experiments in which cells have been irradiated with pairs of ions of variable mean separation. These studies were motivated by the theory of dual radiation action and specifically by the postulate that the lesions responsible for cell impairment by ionizing radiation are formed by the combination of pairs of sublesions that are molecular alterations produced by individual energy transfers in the cell nucleus. It is concluded that the observations are consistent with dual radiation action, and the most striking finding is that there appears to be a bimodal distribution of interaction distances with maxima at less than 0.1 μm and more than 1 μm. Single tracks cause primarily the lesions produced in short-range interactions but they also contribute, at least in late S phase, a relatively small proportion of the long-range interactions which are principally due to a two-track mechanism. The experiments suggest that the radiation-sensitive components of the cell are arranged in a highly nonuniform pattern which may take the form of floccules having diameters of less than 100 nm.

5601 Radiation Effects On Biochemicals

5435 Monomerization of pyrimidine dimers in DNA by tryptophan-containing peptides: wavelength dependence. Sutherland, J.C.; Griffin, K.P. (Brookhaven National Lab., Upton, NY). *USRadiation Research (U.S.);* **83**: No. 3, 529-536(Sep 1980).

Tryptophan-containing peptides and proteins can sensitize the monomerization of pyrimidine dimers in ultraviolet-irradiated DNA; photoreactivating enzymes catalyze the light-induced monomerization of pyrimidine dimers in DNA. It has recently been proposed that a variety of tryptophan-containing proteins and peptides might be confused with true photoreactivating enzymes both in vivo and in vitro. We have thus characterized the wavelengths required for the tryptophan-sensitized dimer monomerization to determine if this process is distinguishable from true enzymatic photoreactivation. We find that 313-nm radiation can monomerize pyrimidine dimers in DNA in the presence of the peptide lysyl-tryptophyl-lysine; however, 334- 365-, and 405-nm radiation are ineffective for fluences up to 1 MJ/m^2. In contrast, each of these wavelengths is capable of monomerizing dimers in the presence of photoreactivating enzymes. Indeed, 334 and 365 nm are always more effective than 313-nm radiation in the case of true enzymatic photoreactivation. The inability of wavelengths other than those near 300 nm to drive the tryptophan-mediated reaction efficiently is consistent with recently reported spectroscopic experiments. The extreme differences in the wavelength specificities for true enzymatic photoreactivation and tryptophan-sensitized monomerization mean that it is easy to differentiate experimentally between the two phenomena. Consideration of the spectral distributions of conventional sources of photoreactivating light indicate that it is extremely unlikely that any of them could contain significant intensities of the wavelengths required for efficient tryptophan-sensitized monomerization of pyrimidine dimers. We thus conclude that tryptophan-sensitized monomerization cannot account for the disappearance of pyrimidine dimers from DNA in cells or cell extracts exposed to photoreactivating light.

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5436 Protection by glycerol against the biological actions of near-ultraviolet light. Peak, M.J.; Peak, J.G. (Argonne National Lab., IL). Contract W-31--109-ENG-38. *USRadiation Research (U.S.);* **83**: No. 3, 553-558(Sep 1980).

Glycerol protects bacterial cells and transforming DNA against both x rays and 365-nm ultraviolet light, but not against 254-nm ultraviolet light. The observation reinforces the concept that 365 nm and ionizing radiation mimic each other in their biological effects and appear more closely related than are 254- and 365-nm ultraviolet light.

5437 Survival of intestinal crypt cells after exposure to high Z, high-energy charged particles. Alpen, E.L.; Powers-Risius, P.; McDonald, M. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *USRadiation Research (U.S.);* **83**: No. 3, 677-687(Sep 1980).

The Withers intestinal crypt clonogenic cell assay has been used to assess the relative effectiveness of high-energy heavy ions for cell killing in this system. The radiation modalities used are 228 MeV/amu helium ions and 400 to 670 meV/amu carbon, neon, and argon ions. These high-LET particle beams have been examined and their effect on both the shoulder of the cell survival curve and the region of exponential cell killing has been examined. All ions except helium are significantly more effective than 225-kVp x rays. There is both an effect on the shoulder, evidenced in a narrowing of this region, and an effect on the exponential region where the D_0 is reduced. This latter finding is in sharp distinction to the effects of neutron beams, where the shoulder is reduced, but the D_0 is unaffected. One of the most significant observations made in these studies is that LET alone does not predict the effectiveness of the various ions. Large differences in effectiveness are seen as a function of atomic number of the particle, even though the LET is held approximately constant.

5438 Initial changes in cell cycle progression of Chinese hamster V-79 cells induced by high-LET charged particles. Geard, C.R. (Columbia Univ., NY). Contract AS02-78EV0-4733. *USRadiation Research (U.S.);* **83**: No. 3, 696-709(Sep 1980).

Asynchronous Chinese hamster V-79 cells were pulse-labeled with tritiated thymidine; then mitotic cells were sequentially colcemid-accumulated after helium ion irradiation. Similar fluences of charged particles depositing intracellularly 63, 90, 128, and 138 keV/μm were delivered at the Radiological Research Accelerator Facility at the Brookhaven National Laboratory. Nuclear cross-sectional areas were log-normally distributed with a mean value of 110 μm^2. An initial decline and subsequent recovery in frequencies of mitotic cells was dose, and to a lesser extent, LET dependent. Cells in S phase at the time of irradiation were dose dependently delayed and then proceeded into mitosis at the same rate as control cells. This was not found for G_2 phase cells, which were delayed and progressively bypassed by S phase cells and probably G_1 cells as both dose and LET increased. The passage of one high LET partice anywhere through a nucleus probably induces some delay response, while particles depositing 63 keV/μm are least effective at eliciting delays. It appears that radiation-induced delays of cellular progression through the cell cycle are optimally effected by particles depositing about 100 keV/μm as has been found for other biological endpoints.

5601 Radiation Effects On Animals

5439 Synergistic effects of different radiations. Zaider, M.; Rossi, H.H. (Columbia Univ., New York). Contract EP-78-S-02-4733. *USRadiation Research (U.S.);* **83**: No. 3, 732-739(Sep 1980).

Theoretical expressions, based on the Theory of Dual Radiation Action, are derived to calculate the effects of mixed radiation

exposures on survival distributions. Temporal effects (such as recovery from sublethal injury) are explicitly included in the calculations. The results indicate the synergistic effect of sequential exposures due to the interaction between sublesions produced by the different types of radiation.

5440 **Intestinal absorption and retention of cadmium in neonatal pigs compared to rats and guinea pigs.** Sasser, L.B.; Jarboe, G.E. (Comparative Animal Research Lab., Oak Ridge, TN). *USJournal of Nutrition, The (U.S.);* **110**: No. 8, 1641-1647(Aug 1980).

The purpose of this study was to measure intestinal absorption and retention of cadmium in the newborn pig and to compare data from the pig, rat and guinea pig, three species that differ greatly in their ability to absorb macromolecules at birth. Newborn pigs were administered a single oral dose of 50 μCi of /sup 115m/Cd 24 hours after birth and killed at intervals between 1 and 14 days after dosing. Cd absorption and gastrointestinal retention were then determined; these data were compared with similar data from the rat and guinea pig. Cd absorption in the neonate appears to be a two-step process; mucosal uptake of Cd from the lumen, probably by pinocytosis, followed by transfer of a portion of this Cd into the body. This transfer process is similar, but does not entirely coincide with changes associated with protein absorption in the neonate.

5441 **Effects of indoor residence on radiation doses from routine releases of radionuclides to the atmosphere.** Kocher, D.C. (Oak Ridge National Lab., TN). *USNuclear Technology (U. S.)Supersedes Nuclear Applications and Technology;* **48**: No. 2, 171-179(Apr 1980).

Dose reduction factors from indoor residence during routine releases of radionuclides to the atmosphere were studied using models that are suitable for application to arbitrary source terms. Dose reduction factors for internal exposure to inhaled radionuclides account for air ventilation and deposition on inside building surfaces. Estimated internal dose reduction factors are ~ 0.2 to 0.8 for particulates and 0.07 to 0.4 for radioiodine. Dose reduction factors for external photon exposure from airborne and surface-deposited sources are based on the point-kernel integration method. Values for source terms from a fuel reprocessing plant and a hypothetical reactor accident are within a factor of 2 of the value 0.5 adopted by the US Nuclear Regulatory Commission (NRC) for population dose assessments. For the release at Three Mile Island nuclear station, however, the external dose reduction factor may be an order of magnitude less than the value adopted by the NRC.

5601 Radiation Effects On Plants

5442 **Induced mutant of Coastcross 1 Bermudagrass with improved winterhardiness.** Burton, G.W.; Constantin, M.J.; Dobson, J.W. Jr.; Hanna, W.W.; Powell, J.B. (Univ. of Georgia, Tifton). *GBEnvironmental and Experimental Botany (England)Supersedes Radiation Botany;* **20**: 115-117(1980).

Coastcross 1 bermudagrass, a sterile F_1 hybrid, establishes faster, yields as much dry matter, is 12% more digestible, and gives 30 to 35% better daily gains and liveweight gains per ha when fed to cattle than does the Coastal clone but fails to develop rhizomes and lacks the winterhardiness of Coastal. To create a winterhardy mutant, some 500,000 green stems were exposed to 7000 rad of ^{60}Co rays at Oak Ridge. TN June 21, 1971 and were immediately planted at Blairsville, GA where relatively severe winters occur frequently. In the growing season following the moderate winter of 1976 to 1977, Coastcross 1-M3 yielded more than Coastcross 1 but only about half as much as Coastal. The severe winter of 1977 to 1978 destroyed about 98% of the plants in the clipped plots of Coastcross 1 and Coastcross 1-M3 but reduced the stand of Coastal very little. The small gain in winterhardiness by Coastcross 1-M3 suggests that several genes control the winterhardiness of well-established Coastal bermudagrass.

5443 **Pulmonary retention of lead: an experimental study in man.** Morrow, P.E.; Beiter, H.; Amato, F.; Gibb, F.R. (Univ. of Rochester, NY). *USEnvironmental Research (U.S.);* **21**: 373-384(1980).

This human investigation of lead absorption from the lungs utilized two forms of lead, lead chloride and lead hydroxide; the former was used in picogram amounts and the latter at microgram levels. These two species of lead were selected in an attempt to simulate the range of physicochemical properties found in atmospheric lead (urban air). Aerosols labeled with lead-203 were made of comparable aerodynamic size by using sodium chloride as the deposition-determining aerosol. After brief, mouthpiece exposures, 17 subjects were followed by serial counting with a thoracic array of scintillation detectors and two leg counters. Serial blood samples were also taken. The two exposure groups showed similar total deposition values (23 vs 26%) and the same biological retention halftimes, viz., 22.6 hr. When the retention data were corrected for blood-borne ^{203}Pb, the biological halftimes for lung lead retention averaged 13.1 and 14.2 hr, respectively, and were not significantly different. The collective evidence supports the view that atmospheric lead is rapidly and completely absorbed from the human lungs.

5444 **Absorption of methylmercury by the fetal guinea pig during mid to late gestation.** Kelman, B.J.; Steinmetz, S.E.; Walter, B.K.; Sasser, L.B. (Comparative Animal Research Lab., Oak Ridge, TN). *USTeratology (U.S.);* **21**: 161-165(1980).

Pregnant guinea pigs were injected with CH_3 $^{203}HgCl$ at 22, 40, 47, 59, and 66 days of gestation, and fetal tissues were obtained 24 hours later. Autologous fetal erythrocytes were labeled with ^{51}Cr and used to label the fetal blood pool at each gestational age except 22 days so that tissue-bound Hg could be calculated. In general, Hg absorbed by the whole fetus increased during gestation, in parallel with increasing tissue mass, while Hg found in whole placentas remained the same. Liver, kidney, blood, and brain contained the highest Hg concentration early in gestation. While it is difficult to interpret the potential effects of the increased Hg concentrations, particular attention should be paid to the brain, since it is considered a target tissue in MeHg toxicity.

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5445 **DNA repair and longevity in three species of cold-blooded vertebrates.** Woodhead, A.D.; Setlow, R.B.; Grist, E. (Brookhaven National Lab., Upton, NY). Contract YOL-CP-50202. *GBExperimental Gerontology (England);* **15**: 301-304(1980).

The error catastrophe mechanism of ageing proposes that senescence results from the progressive accumulation of unrepaired damage to DNA throughout the life span. Studies of the changes in DNA repair capability in ageing cells both in vivo and in vitro have given ambiguous results, but a clear relation has been demonstrated in mammals between the DNA repair capacity and potential longevity. We have found no difference in excision repair capacity in cultured cells from three species of cold-blooded vertebrates, the long-lived turtle, with a potential life span of 118+ yr, the rainbow trout, 8 yr, and Amazon molly, with 3 yr.

5446 **Synthesis of 6-radioiodo-6-deoxy-d-galactose, and its tissue distribution and excretion in rats.** Flanagan, R. (Univ. of Alberta, Edmonton); Lentle, B.C.; Wiebe, L.I.; Helus, F.; Maier-Borst, W. pp 119-128 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

6-Radioiodo-6-deoxy-D-galactose was prepared by thermal neutron irradiation of the non-radioactive compound, and by iodine exchange on 6-iodo-1,2:3,4-diisopropylidene-6-deoxygalactose with either NaI-125, NaI-131 and $MgSO_4$, or I-123 on gold foil. The diisopropylidene compound ws deblocked with aqueous acid to obtain the labeled sugar. Upon IV injection of I-125 or I-131 labeled 6-iodo-6-deoxygalactose into rats, rapid renal and heptic uptake resulted in elimination of 22% and 36% of the dose in 4 hour bile and 4 hour urine respectively. About 2% of a dose remained in the bodies of iodide pretreated rats, 24 hours after injection. After 4 hours, tissue: blood ratios ranged from 0.3 (Skeletal muscle) to 3.8 (kidney). Although iodogalactose was found to be stable in saline at room temperature, label integrity in vivo was compromised after

about 4 hours. Bile contained primarily free radioiodide, whereas urine contained mainly radioiodogalactose with varying proportions of radioiodide.

5447 **Kinetics of uptake and macromolecular binding of Ga-67 and Fe-59 by the EMT-6 sarcoma-like tumor of BALB/c mice.** Larson, S.M.; Rasey, J.S.; Nelson, N.J.; Grunbaum, Z.; Allen, D.R.; Harp, G.D.; Williams, D.L. (Univ. of Washington, Seattle). pp 297-308 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

In order to compare the subcellular metabolism of ^{67}Ga and ^{59}Fe, we have studied the EMT-6 sarcoma of BALB/c mouse, a tumor with both in-vitro and in-vivo growth forms. In-vitro ^{67}Ga and ^{59}Fe show similar temporal uptake profiles into exponentially growing EMT-6 cells, with a gradual increase over the first 24 hours of incubation and subsequent decine thereafter. In-vivo, 24 hours after intravenous administration of ^{67}Ga-citrate and ^{59}Fe-citrate to mice bearing subcutaneous EMT-6 tumors, most of the subcellular ^{67}Ga and ^{59}Fe is bound to discrete macromolecular components of approximate molecular weight, as follows: >250,000 MW, 80 to 90,000 MW, and 40 to 60,000 MW.

5448 **Differential uptake of ^{67}Ga in canine tumors and abscesses.** Terner, U.K.; Wong, H.; Noujaim, A.; Lentle, B.C.; Hill, J.R. (Univ. of Alberta, Edmonton). pp 309-319 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Differentiation between the radiogallium uptake in canine tumor and abscesses was affected by using a double-labeled ^{67}Ga-^{125}I-transferrin and by measurement of the ratio of isotopes at various time intervals. An alternative procedure consisted of the injection of a mixture of ^{67}Ga-transferrin and ^{68}Ga-citrate and the estimation of the ^{67}Ga/^{68}Ga ratio over the region of interest. Transferrin in receptor sites which are only present on tumor cell membranes are responsible for the differential uptake. This technique could be of potential value in distinguishing tumors from abscesses upon clinical imaging. While the mechanism of gallium uptake in tumors was found to be specific and mediated solely through transferrin this was not the case in abscesses. Incorporation of radiogallium in inflammatory conditions appears to be non-specific and not due to the in vivo labeling of leucocytes.

5449 **Pharmacokinetics: curiosity or cure.** Notari, R.E. (Ohio State Univ., Columbus). pp 395-404 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

What is the fate of a drug from the time of its introduction into the body to the end of its duration. Pharmacokinetic studies are often designed to provide an answer to this question. But this question may be asked of any drug and research that is limited to answering it will remain empirical. Pharmacokinetic studies can provide answers to many other drug-related questions. In doing so pharmacokinetic research has the potential of improving drug therapy as well as the design and evaluation of drugs. While significant contributions can be cited, the future of pharmacokinetics depends upon its increased impact on clinical practice and drug design. How can a molecule be tailored for site specificity. Can chemical modification selectively alter absorption, distribution, metabolism, binding or excretion. In what new ways can pharmacokinetic information increase the predictability of drug therapy. Such questions, to which pharmacokinetics should provide answers, are numerous and easily identified. But the definitive studies are difficult both to create and conduct. Whether or not pharmacokinetics can achieve its full potential will depend upon the extent to which it can provide answers to these currently unanswered questions.

5450 **Nuclear pharmacology/radiopharmacokinetics, a new dimension of radiopharmacy/nuclear medicine.** Wolf, W.; Manaka, R.C.; Young, D.; Schumitzky, A.; Siemsen, J.K.; Shani, J. (Univ. of Southern California, Los Angeles). pp 405-420 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Radiopharmacokinetics is defined as the mathematical and experimental method pertinent to the use of gamma labeled drugs, whereby chemotherapy can be optimized for an individual patient through the use of the non-invasive techniques of nuclear medicine, by providing input specifically useful to clinical pharmacology. The present paper lays the foundation and presents the basic methodology necessary to utilize information gleaned from this novel use of gamma labeled chemotherapeutic agents. The kinetic area of interest results are analyzed with the aid of identification theory methods, so as to help identify uniquely the amount of a gamma labeled drug present in a given organ or tissue. The problem of controllability of drug administration is then to be determined with the use of these techniques. We propose that this new subspecialty of nuclear medicine be known as Nuclear Pharmacology.

5451 **Pharmacodynamics of stannous-chelates administered with technetium-99m-chelates for radionuclide imaging.** Dewanjee, M.K.; Anderson, G.S.; Wahner, H.W. (Mayo Clinic, Rochester, MN). pp 421-433 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The pharmacodynamics of tin compounds, given as tin-human serum albumin (Sn-HSA), tin-glucoheptonate (Sn-GH), tin-dimercaptosuccinate (Sn-DMSA), tin-pyrophosphate (Sn-PP), tin-diethylenetriaminepentaacetate (Sn-DTPA), and tin-hydroxyethylene diphosphonate (Sn-HEDP), all labeled with ^{113}Sn, were studied in rabbits. Biodistribution, equilibrium dialysis with human serum albumin and red cell hemolysate, and autoradiography were used. The results show that (1) Sn-chelates of PP, HEDP, DTPA, HIDA, and GH are unstable in vivo and give rise to free stannous ion; (2) free stannous ion localizes mainly in bone, and most of the rest is excreted in the urine; (3) Sn-DMSA is a stable chelate, and its biodistribution pattern is more like that of the corresponding Tc-99m-DMSA chelate; (4) binding of stannous chelates with serum protein, specifically human serum albumin, is weak when compared with that of the corresponding Tc-99m chelates; (5) binding of stannous ion with hemoglobin is higher than with human serum albumin; (6) skeletal uptake, intrarenal distribution and renal excretion of Sn-chelates are similar to other divalent cations. Tin-chelates, administered by necessity together with Tc-99m, show pharmacodynamics different from those chelates of the corresponding Tc-99m chelates.

5452 **Affinity constants of technetium-99-pertechnetate and Tc-chelates with human serum albumin.** Dewanjee, M.K.; Brueggemann, P.; Wahner, H.W. (Mayo Clinic, Rochester, MN). pp 435-447 of Radiopharmaceuticals. II. New York, NY; Society of Nuclear Medicine, Inc. (1979).

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

The affinity constants (AC) characterizing the binding of pertechnetate (TcO_4-) and Tc-chelates with human serum albumin (HSA) have been determined using equilibrium dialysis and Tc-99m tracer. Tc-99-Hydroxyethylene diphosphonate (Tc-HEDP), Tc-99-pyrophosphate, Tc-99-glucoheptonate, Tc-99-dimercaptosuccinate, and Tc-99-N (dimethylphenylcarbamoylmethyl)-iminodiacetate were prepared by stannous chloride reduction in nitrogen-purged saline. Scatchard plot from TcO_4- showed a single slope; AC was $\cong$ 1.96 x 10^3 and molar ratio of TcO_4- and HSA was 1:1. Also, for Tc-HEDP, a single slope was obtained (AC = 7.8 x 10^4). For the other Tc-chelates tested, two slopes were found. The ranges of low and high AC values were (1.9 to 22.9) x 10^3 and (0.6 to 1.4) x 10^5 respectively. These AC values reflect the relative strength of interaction between HSA and Tc-99m-chelates and explain differences among Tc-99m-chelates in initial volume of distribution, renal clearance, and mechanism of localization in certain tumor and necrotic tissue.

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5453 **DNA repair and its coupling to DNA replication in eukaryotic cells.** Cleaver, J.E. (Univ. of California, San Francisco). *NLBiochimica et Biophysica Acta (Netherlands);* **516**: 489-516(1978).

This review article with 184 references presents the view that mammalian cells have one major repair system, excision repair, with many branches (nucleotide excision repair, base excision repair, crosslink repair, etc.) and a multiplicity of enzymes. Any particular carcinogen makes a spectrum of damaged sites and each kind of damage may be repaired by one or more branches of excision repair. Excision repair is rarely complete, except at very low doses, and eukaryotic cells survive and replicate DNA despite the presence of unrepaired damage. An alteration in a specific biochemical pathway seen in damaged or mutant cells will not always be the primary consequence of damage or of the biochemical defect of the cells. Detailed kinetic data are required to understand comprehensively the various facets of excision repair and replication. Correlation between molecular events of repair and cytological and cellular changes such as chromosomal damage, mutagenesis, transformation, and carcinogenesis are also rudimentary.

5602 Thermal Effects

5454 (COO—4733-3, pp 233-242) **Development and decay of thermotolerance.** Freeman, M.L. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1979-September 30, 1980.

The relationship between cell inactivation and the duration of a heat treatment is sigmoidal in shape in most cases. The present study was initiated to investigate the development and decay of a thermotolerance, a phenomenon whereby cells, heated for periods greater than 200 to 300 minutes, became refractory to killing by heat, in the hope that a better understanding of the mechanism of hyperthermic induced cell killing may be achieved.

5455 **(PB—80-166440) Integration of biological with thermal criteria for power plant design and water resource use. Technical completion report.** Magnuson, J.J.; Medvick, P A.; Gallepp, G.W.; Hall, R.J.; Rasmussen, P.W. (Wisconsin Univ., Madison (USA). Water Resources Center). 1979. Contract DI-14-31-0001-5133. 64p. NTIS, PC A04/MF A01.

The energetic consequences of heated effluent from a 220 MW generating plant on the growth and production of bluegill in a 1400 ha eutrophic lake were analyzed. The heated effluent altered temperatures of 1-2% of the lake surface area or 2.6% of its littoral zone. In winter bluegill released near the outfall tended to remain in the heated water and remained closer to shore than in other seasons. Growth of bluegill was compared between the outfall and reference area from measurements of fish held in each area in enclosures, and from growth simulation using a bioenergetic model for fish growth. Fish in cages usually grew more rapidly in the outfall, but simulated growth was slightly lower in the outfall area. A strong argument cannot be made for major effects of the heated effluent on growth. Based on the observed growth of caged fish and high population density in the outfall area, small bluegill in the littoral zone may have a 20% enhancement of production during summer. The results indicate that a small electric generating station in an urban area can use the local eutrophic lake as a source of once-through cooling water without negative effects on the growth and production of the dominant warmwater fishes.

5603 Chemicals Metabolism And Toxicity

5456 **(COO—2532-5) Effects of environmental stresses on the species composition of phytoplankton populations. Final report, 1 March 1979-15 July 1980.** Ryther, J.H.; Sanders, J.G. (Woods Hole Oceanographic Institution, MA (USA)). Jul 1980. Contract AS02-76EV02532. 134p. NTIS, PC A07/MF A01.

Studies concerned with the impact of anthropogenic stress associated with coastally located power plants on the species composition of marine phytoplankton assemblages have been underway under this Contract for 24 months. The impact of three pollutants associated with power plant cooling water systems has been studied: copper, chlorine, and thermal elevation. The primary goal has been to determine whether chronic addition of these pollutants at sublethal levels can affect the species composition and the succession of dominant species in natural phytoplankton assemblages. Stresses have been studied both singly and in combination. In conjunction with these primary objectives, a number of related problems imvolving phytoplankton response to pollutants and to zooplankton grazing have been studied. These experiments have been performed both in the large volume enclosures outdoors, and in laboratory cultures under constant conditions.

5457 (COO—4733-3, pp 155-165) **Oncogenic transformations in vitro produced by misonidazole.** Miller, R.C.; Hall, E.J. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

The report that metronidazole induces mutations in vitro and multiple tumor types in vivo, while misonidazole induces mutations and oncogenic transformations in vitro, have raised questions concerning the possible adverse long term effects of these radiosensitizers. The present report compares misonidazole with a number of other radiosensitizers using an established cell line to score oncogenic transformations in vitro. The four electron affinic compounds studied were misonidazole (Ro-07-0582), desmethylmisonidazole (Ro-05-9963), Ro-07-0741 and SR 2508.

5458 (COO—4733-3, pp 197-208) **Liver cells in culture: a model for investigating the regulation of retinol-binding protein metabolism.** Borek, C.; Smith, J.E.; Goodman, D.S. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1979-September 30, 1980.

This report details the development of an in vitro model of liver cells in culture which will produce retinol binding protein (RBP) which has a single binding site for one molecule of retinol. The cellular and molecular mechanisms of RBP production and secretion are discussed.

5459 (COO—4733-3, pp 221-232) **In vitro studies with cis-platinum diammide dihydrochloride and exogenous polyamines.** Roizin-Towle, L.; Capuano, L. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1979-September 30, 1980.

The action of naturally occurring polyamines putrescine, spermine and spermidine on the effectivenss of cis diamminedichloro-platinum (Cis-DDP), an antineoplastic agent, was investigated. In vitro studies with Chinese hamster V-79 cells showed convincingly that for this particular antineoplastic agent, cytotoxicity is reduced by elevated levels of polyamines. (KRM)

5460 (COO—4733-3, pp 271-283) **Effects of long contact times of misonidazole on attached Chinese hamster V-79 cells.** Geard, C.R.; Rutledge-Freeman, M.H. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

This study presents data on sister chromatid exchanges (S.C.E.'s), chromosomal aberrations, cell cycle effects, and cell survival after incubating attached Chinese hamster V-79 cells with misonidazole for 24, 48, and 72 hours. Increases in S.C.E's were comparatively small and chromosomal aberrations few, even when 90% of cells failed to survive, while progression through the cell cycle was slowed both by increasing drug concentrations and contact times.

5461 (COO—4733-3, pp 284-294) **Clastogenic effects of misonidazole on aerated and hypoxic cells in vitro.** Geard, C.R.; Schwartz, L.E.; Rutledge-Freeman, M. Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

The studies reported here were designed to assess potentially hazardous effects and to address the mechanisms responsible for the cytotoxic effects of the drug. Clonogenicity, progression through the cell cycle, chromosomal aberrations, sister chromatid exchanges and oncogenic transformations have been scored in aerated mouse

C3H/10T1/2 fibroblasts treated with misonidazole, and in aerated and hypoxic Chinese hamster V-79 cells.

5462 **(DOE/ET/11284—T5) Effects of by-products from coal-gasification and fluidized bed combustion processes on alveolar macrophages of newborn dogs. Year end progress report, September 1, 1979-August 30, 1980.** Lee, P. (West Virginia Univ., Morgantown (USA)). 1980. Contract AT21-79MC11284. 17p. NTIS, PC A02/MF A01.

It was shown that the aqueous baghouse ashes provided by METC produce both inhibitory and stimulatory response in chemiluminescence in dog alveolar macrophages. These effects can be removed by treating the extracts with activated charcoal. This may have important implication in the handling of disposal and detoxification of these ashes.

5463 **Azide.** Kleinhofs, A.; Owais, W.M.; Nilan, R.A. *NLMutation Research (Netherlands)Absorbed Newsl. Environ. Mutagen Soc.;* **55**: 165-195(1978).

The mutagenicity and toxicity of sodium azide and potassium azide are reviewed. Some chemical reactions of interest for the understanding of the mechanisms of azide mutagenesis and toxicity and summarized. The chemical and physical properties of azides are discussed. Most of the physiological and toxicological properties of azides can be traced to its effect on enzymes containing a coordinated divalent metal ion. The acute toxiciology is described. There is not sufficient information on chronic exposure to small quantities of azides. The mutagenic action of azides in bacteria and barley is described. The mutagenicity of organic azides is also discussed.

5464 **(PB—80-169097) Health hazard evaluation determination report HE 79-51-664, Gates Energy Products, Inc., Denver, Colorado.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1980. 12p. NTIS, PC A02/MF A01.

An environmental and biological survey was conducted on March 13-15, 1979, to evaluate potential overexposures at the Gates Energy Products Co. Breathing zone air samples were taken on workers in all areas for lead determination. Methyl chloroform samples were taken in one area where perforated lead sheets were cleaned with methyl chloroform. Blood samples were taken on 217 workers, and a brief work history questionnaire given to each one. Fifty-four percent of the lead air samples taken exceeded the Occupational Safety and Health Administration (OSHA) standard of 0.05 mg/cu M. None of the methyl chloroform samples exceeded the 1979 ACGIH Threshold Limit Value (TLV) of 1900 mg/cu M. Lead was analyzed in 217 blood samples. Forty-four percent of these samples exceeded the OSHA standard of 40 micrograms Pb/100 grams of whole blood (40 micrograms Pb/100 g). Thirty-seven percent were between 40-60 micrograms Pb/100 grams of whole blood. Six percent were between 60-80 micrograms Pb/100 grams of whole blood and one percent exceeded 80 micrograms Pb/100 grams of whole blood. On the basis of these environmental and medical data, it was concluded that a health hazard existed from overexposure to lead.

5465 **(PB—80-169220) Pilot study of ambient air pollution and survival from cancer.** Wilkinson, G.S.; Reese, P.A.; Priore, R.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Jan 1980. 32p. NTIS, PC A03/MF A01.

The study was concerned with investigating the potential influence exerted by ambient concentrations of particulate and sulfur dioxide air pollutants upon the length of survival for diagnosed cancer patients. Monitoring data from the National Aerometric Data Bank for particulates and sulfur dioxide were examined in conjunction with survival data from the Lake Area Regional Tumor Service Registry. Length of survival for respiratory cancer patients was found to be inversely related to maximum particulate levels. Survival times for patients who resided in areas where maximum particulate levels exceeded 240 micrograms/cu m were significantly shorter than for similar patients who resided in areas with lower particulate levels. Colorectal cancer patients demonstrated a similar trend that was not statistically significant. No association was found between survival of leukemia patients and particulate or SO2 levels, nor was SO2 related to survival of respiratory tract or colorectal cancer patients. These findings suggest that highly polluted air in residential areas may have a deleterious effect on the survival time of patients with certain types of neoplastic disease. Additional research is called for of the relationship between cancer survival and exposure to ambient air pollution, especially particulates.

5466 **(PB—80-169568) Health effects research program. Summary report for fiscal years 1974-1978.** Thomas, R.D.; Taylor, A.D.; Gordon, J.G. (Mitre Corp., McLean, VA (USA). METREK Div.). Dec 1979. Contract EPA-68-01-5051. 149p. NTIS, PC A07/MF A01.

The Federal Interagency Energy/Environment Research and Development Program which is coordinated by the U.S. Environmental Protection Agency was initiated in the latter half of fiscal year 1974 to ensure that health and environmental problems related to energy resource development would be anticipated and evaluated. This document provides an overview of the Interagency-supported health effects research program from an administrative as well as various technical perspectives. In this updated program review, which is based on the individual task progress reports available for fiscal years 1974 through 1978, the research projects are reviewed and discussed according to King-Muir objectives and selected scientific discipline, biological endpoint, and agent/pollutant categories.

5467 **(PB—80-810427) Air pollution effects on plants (citations from the American Petroleum Institute Data Base). Report for 1974-Feb 80.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). May 1980. 275p. NTIS PC N01/MF N01.

The bibliography cites abstracts which are concerned with the effects of combustion products, industrial and automotive emissions on vegetation, forestry, and agricultural crops. Also included are plant responses when exposed to different levels of ozone. (This updated bibliography contains 268 abstracts, 62 of which are new entries to the previous edition.)

5468 **(PNL-SA—8679) Modeling the dose-response relationship for cytotoxicity of human cells exposed to chemical carcinogens.** Miller, J.H.; Heflich, R.H. (Battelle Pacific Northwest Labs., Richland, WA (USA); National Center for Toxicological Research, Jefferson, AR (USA)). Sep 1980. Contract AC06-76RL01830. 22p. (CONF-801039—5). NTIS, PC A02/MF A01.

From 20. annual Hanford Life Sciences symposium; Richland, WA, USA (19 Oct 1980).

Compounds like N-acetoxy-2-acetylaminofluorene (N-AcO-AAF) result from the in vivo reduction of nitrate derivatives of benzo[α]pyrene. The dose-response relationship for survival of cloning ability in human fibroblasts exposed to N-AcO-AAF is being investigated to obtain a better understanding of the carcinogenic potential of coal-related air pollutants. A model is presented which correlates the survival of normal human fibroblasts after exposure to N-AcO-AAF with the rate of excision of carcinogen residues bound to DNA. The model predicts that the survival of normal cells, S/sub N/, is related to the survival of repair deficient cells, S/sub XPA/, by the equation ln(S/sub N/) = ln(S/sub XPA/) (1-f) where f is the fraction of potentially lethal damage repaired in the normal cell at a given dose of carcinogen. The rate of excision of AAF residues from the DNA of confluent human fibroblasts was measured over the same dose range as the survival studies. This information together with the dose-response relationship for survival of normal and repair deficient cells permits a determination of the mean number of adducts required to produce a potentially lethal lesion and the effective time available for repair. The model can be used to predict the mean lifetime of carcinogen residues on the DNA of partially repair deficient cells and the effect of recovery on the survival of normal cells. Extensions of the model to account for shoulders on the dose-response relationship curves are also discussed.

5469 **Enantiomeric interaction in the metabolism and tumorigenicity of (+)- and (-)-benzo[a]pyrene 7,8-oxide.** Levin, W.; Buening, M.K.; Wood, A.W. (Hoffman-LaRoche, Inc., Nutley, NJ). *USJournal of Biological Chemistry, The (U.S.);* **255**: No. 19, 9067-9074(10 Oct 1980).

The (+)- and (-)-enantiomers of benzo[a]pyrene 7,8-oxide are hydrated stereospecifically at C-8 to (-)- and (+)-trans-7,8-dihydroxy-7,8-dihydrobenzo[a]pyrene, respectively, by rat hepatic epoxide hydrolase. The (-)-enantiomer of benzo[a]pyrene 7,8-oxide is metabolized by microsomal epoxide hydrolase at a rate 3- to 4-fold greater than the (+)-enantiomer. At low conversion of racemic substrate, however, benzo[a]pyrene 7,8-oxide is metabolized to the dihydrodiol at a rate equal to that of the (+)-enantiomer. An analysis of the enantiomeric composition of the dihydrodiol formed from the racemic substrate revealed preferential formation of (-)-trans-7,8-dihydroxy-7,8-dihydrobenzo[a]pyrene. At low substrate conversion (<20% metabolism), the enantiomeric purity of the dihydrodiol was much higher than at high substrate conversion (>50% metabolism). Similar results were obtained with microsomes from hamster, rabbit, guinea pig, mouse, and human liver. These results indicate that epoxide hydrolase has a higher affinity for (+)-benzo[a]pyrene 7,8-oxide than for the (-)-enantiomer. The kinetics of hydration of (+)- and (-)-benzo[a]pyrene 7,8-oxide by purified epoxide hydrolase in detergent solution showed the (+)- and (-)-enantiomers to have apparent K/sub m/ values of 1.7 and ≧ 20 μm, respectively. Tumorigenicity studies with benzo[a]pyrene 7,8-oxide on mouse skin and in newborn mice revealed that (+)-benzo[a]pyrene 7,8-oxide, the metabolic precursor of the more tumorigenic (-)-7,8-dihydrodiol, is significantly more tumorigenic than the (-)-enantiomer. However, racemic benzo[a]pyrene 7,8-oxide was more tumorigenic than either enantiomer alone, indicating an enantiomeric synergism in the carcinogenicity of benzol[a]pyrene 7,8-oxide. The data are discussed in relation to the complete sequence of metabolic pathways leading to an ultimate carcinogen from benzo[a]pyrene.

5470 **Chemical characterization of coal fly ash and quantification of lung deposition in rodent inhalation studies.** Fisher, G.L.; Silberman, D.; Raabe, O.G. (Univ. of California, Davis). *USEnvironmental Research (U.S.);* **22**: No. 2, 298-306(Aug 1980).

Studies of the elemental content of reaerosolized coal fly ash revealed increased concentrations of biologically active trace elements, Cd, Co, Cr, Cu, V, and Zn, compared to the initial stock material. Concentrations of the matrix elements, Al, Si, and Ti, were not altered during reaerosolization. Because of the absence of concentration dependence on particle size and on analytical recovery experiments, aluminum was chosen as an indicator element for quantification of lung-deposited fly ash in rat inhalation studies. Calculated lung depositions for inhaled fly ash were in agreement with expected values.

5471 **Mortality among men occupationally exposed to phosgene in 1943-1945.** Polednak, A.P. (Oak Ridge Associated Univ., TN). *USEnvironmental Research (U.S.);* **22**: No. 2, 357-367(Aug 1980).

Mortality and causes of death as reported on death certificates were described among white male workers exposed to phosgene in 1943 to 1945 at a uranium-processing plant in Tennessee. Standardized mortality ratios (SMRs) were calculated by using death rates for United States white males. As of 1974, SMRs for all causes and for various selected causes were similar in 699 chemical workers chronically exposed to low levels of phosgene (and to daily episodes of levels above 1 ppM) and in 9352 controls who worked at the same plant. SMRs for diseases of the respiratory system were 78 and 113 in the chemical workers and controls, respectively. A group of 106 male chemical and other workers was acutely exposed to higher levels of phosgene (i.e., above 50 ppM, based on clinical symptoms), and 25 had X-ray evidence of acute pneumonitis. Among the 106 men, one death from pulmonary edema due to phosgene poisoning occurred less than 24 hr after exposure, and a total of 30 deaths occurred as of 1974 (SMR = 113); there were no deaths from lung cancer, but three deaths (vs 1.37 expected) were due to respiratory diseases. Further follow-up of these groups is needed, including data on morbidity as well as mortality.

5472 **Separation of neutral nitrogen compounds from synthetic crude oils for biological testing.** Ho, C.H.; Ma, C.Y.; Clark, B.R.; Guerin, M.R.; Rao, T.K.; Epler, J.L. (Oak Ridge National Lab., TN). *USEnvironmental Research (U.S.);* **22**: No. 2, 412-422(Aug 1980).

Isolation of neutral N-PAHs(PAH homologues containing one or more ring nitrogens) is achieved in three steps using acid-base extraction, gel filtration on Sephadex LH-20, and adsorption chromatography on silicic acid. Gas chromatographic/mass spectrometric analysis of the neutral N-PAH fractions indicated the following as mator components; C_1-C_3 phenylpyrroles, indole, C_1-C_6 indoles, C_1-C_3 phenylindoles, carbazole, C_1-C_6 carbazoles, benzocarbazoles, and C_1-C_3 benzocarbazoles. The neutral N-PAH fractions were subjected to mutagenicity tests using Salmonella typhimurium/microsomal activation systems devised by Ames. The neutral N-PAH fraction of the coal-derived oil had a specific activity more than twice that of the PAH fraction of the same oil, whereas the shale oil neutral N-PAH fraction showed no activity. These results are discussed in the context of previous work with these oils and with some pure neutral N-PAH compounds.

5473 **Fate of inhaled fly ash in hamsters.** Wehner, A.P.; Wilkerson, C.L.; Mahaffey, J.A.; Milliman, E.M. (Pacific Northwest Labs., Richland, WA). *USEnvironmental Research (U.S.);* **22**: No. 2, 485-498(Aug 1980).

To determine pulmonary deposition, translocation, and clearance of inhaled fly ash, hamsters received a single 95-min nose-only exposure to neutron-activated fly ash. Over a period of 99 days postexposure, the hamsters were sacrificed in groups of six animals. Lungs, liver, kidneys, decapitated and skinned carcass, pelt, head, gastrointestinal tract, urine, and feces were collected for analysis of the radionuclide tracers ^{46}Sc, ^{59}Fe, and ^{60}Co by γ-ray spectrometry. The fly ash burden estimates as determined by the radionuclides ^{46}Sc and ^{59}Fe are in good agreement for the majority of samples analyzed. An estimated average of 63 μg fly ash, or 2 to 3% of the inhaled fly ash, was initially retained in the respiratory tract. The estimated biological half-times of the fly ash were 2.6 and 34.5 days, probably for the airways and for the deep lung, respectively. After 99 days, the mean lung burden had decreased to about 10% of its initial value.

5474 **Model for the exposure of individual lung cells to the foreign elements contained in fly ash.** Hayes, T.L. (Univ. of California, Berkeley); Pawley, J.B.; Fisher, G.L.; Goldman, M. *USEnvironmental Research (U.S.);* **22**: No. 2, 499-509(Aug 1980).

The exposure of the individual cells of lung tissue to the chemical elements associated with fly ash particles is a very sensitive function of the elemental distribution among individual particles. There is evidence that the individual particle chemistry is not homogeneous with respect to major element composition among particles and that many of the elements are found in high concentration in a few particles rather than existing in relatively uniform concentration among all of the particles. This segregation of elements in specific particles results in the possibility for significantly higher exposure levels within individual cells than those projected from the model of the elemental concentrations distributed uniformly among the particles.

5475 **Differential life-stage susceptibility of Acheta domesticus to acridine.** Walton, B.T. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *USEnvironmental Entomology (U.S.);* **9**: No. 1, 18-20(Feb 1980).

The toxicity of acridine to Acheta domesticus (L.) was determined to evaluate the potential for this pollutant from synthetic fuels production to affect insect populations. Acridine was highly toxic to cricket eggs but not toxic to nymphs or adults. An LD_{50} for eggs = 7.4 μg/g was calculated from the LC_{50} = 15.1 +- 0.61 ppM. The 24-h LD_{10} of acridine to nymphal crickets was > 332 μg/g. Male and female crickets consumed up to 1.0% of their weight in acridine over an 18-day period with no significant effect on mortality, weight gain, digestibility of food, or fecundity. Percent hatch of eggs from treated crickets (81.0 +- 6.7) was not significantly different from controls (77.2 +- 5.1).

5476 Salmonella mutagenicity assay: reproducibility. *NLMutation Research (Netherlands)Absorbed Newsl. Environ. Mutagen Soc.;* **74**: 379-400(1980).

This letter to the editor presents an interlaboratory comparison of data from the Ames Salmonella mutagenicity assay from 2 different laboratories. They suggest that the variation seen with various strains of Salmonella are intrinsic variations due to the complexity of the processes of mutation rather than to laboratory conditions. (KRM)

5477 Effects of doxorubicin and its aglycone metabolite on calcium sequestration by rabbit heart, liver, and kidney mitochondria. Revis, N.W.; Marusic, N. (Oak Ridge National Lab., TN). *USLife Sciences (U.S.)Divided into Parts I and II; reverted to former title with Vol. 13, No. 1, July 1, 1973;* **25**: No. 12, 1055-1063(17 Sep 1979).

Previous investigators have shown that following doxorubicin treatment heart mitochondria appear swollen and contain intramitochondrial dense inclusion bodies identified as calcium phosphate. In vitro studies have shown that similar morphological changes occur in mitochondria previously loaded with excess calcium. The present studies were performed to determine the effects of doxorubicin and its aglycone metabolite on $^{45}Ca^{2}+$ uptake by mitochondria isolated from the heart, liver, and kidney of the rabbit. Doxorubicin (100 μM) significantly inhibited the initial rate of $^{45}Ca^{2}+$ accumulated by mitochondria isolated from the three tissues. In contrast, the aglycone metabolite (100 μM) induced the reverse effect. In preloaded mitochondria the aglycone stimulated the release of calcium while doxorubicin was without effect. Mitochondria from the heart were significantly more sensitive to the effects of these anthracyclines than were mitochondria from the other two tissues. If these in vitro effects also occur in vivo, then the aglycone metabolite would be a more likely candidate in explaining the morphological changes in heart mitochondria previously described.

5478 ^{3}H-benzene metabolism in rabbit bone marrow. Andrews, L.S.; Sasame, H.A.; Gillette, J.R. (National Institutes of Health, Bethesda, MD). *USLife Sciences (U.S.)Divided into Parts I and II; reverted to former title with Vol. 13, No. 1, July 1, 1973;* **25**: No. 7, 567-572(13 Aug 1979).

An assay for benzene metabolism using ^{3}H-benzene and high pressure liquid chromatography was developed. ^{3}H-Benzene metabolism (2 pmoles benzene equivalents/mg protein/min) required the presence of a TPNH generating system and was inhibited 80% in the presence of a CO:O_2 (9:1) atmosphere. The products of ^{3}H-benzene rabbit bone marrow microsomal metabolism were phenol and an unidentified metabolite. Cytochrome P-450 (26 to 51 pmoles/mg microsomal protein) and cytochrome c reductase activity (7.8 to 21.0 nmole/mg microsomal protein/min) were detected in rabbit bone marrow.

5479 Tumor promoter 12-0-tetradecanoyl-phorbol-13-acetate elevates serum progesterone levels. Sharma, O.K.; Kerr, S.J. (AMC Cancer Research Center, Lakewood, CO). *USBiochemical and Biophysical Research Communications (U.S.);* **87**: No. 4, 1039-1043(27 Apr 1979).

The phorbol ester 12-0-tetradecanoyl-13-acetate (TPA), the most potent promoter of two-stage carcinogenesis in mouse skin, simulates some of the early effects of several carcinogens in immature chicks. Actinomycin D, ethionine, thioacetamide (non-mutagenic in the Ames Salmonella test) and kepone are known to increase serum progesterone concentrations and induce synthesis of ovalbumin in chicks. Intraperitoneal administration of TPA to chicks caused a 5- to 7-fold elevation of serum progesterone levels and induced ovalbumin synthesis. Phorbol ester, 4α-phorbol-12, 13-didecanoate, which is inactive as a mouse skin tumor promoter, did not increase serum progesterone levels nor did it induce ovalbumin synthesis.

5480 Increased serum erythropoietin activity in rats following intrarenal injection of nickel subsulfide. Hopfer, S.M.; Sunderman, F.W. Jr.; Fredrickson, T.N.; Morse, E.E. Contract EY-76-S-02-3140. *USResearch Communications in Chemical Pathology and Pharmacology (U.S.);* **23**: No. 1, 155-170(Jan 1979).

To investigate the pathopysiologic mechanisms of nickel-induced erythocytosis, serum erythropoietin activities were measured in (a) pooled serum from rats at 2 wk after intrarenal injection of αNi_3S_2 (5 mg/rat), and (b) pooled serum from control rats at 2 wk after intrarenal injection of sterile NaCl vehicle (0.4 ml/rat). A sensitive erythropoietin bioassay was employed, which entailed repetitive administration of test serums to post-hypoxic polycythemic mice in divided doses (12 s.c. injections of 0.5 ml of serum at 6 h intervals for 3 da; total dose = 6 ml of serum/mouse). The erythropoietin detection limit was $\cong$ 20 I.U./liter of serum. In mice which received pooled serum from αNi_3S_2-treated rats, erythrocyte ^{59}Fe-uptake averaged 28% (S.D. +- 5) (vs 3.7 +- 1.1% in control rats; $P < 0.001$). Based upon a 7-point calibration plot, the erythropoietin activity in pooled serum from αNi_3S_2-treated rats averaged 130 I.U./liter (S.D. +- 18) (vs 27 +- 6 I.U./liter in control rats; $P < 0.001$). In vitro addition of Ni(II) to rat serum (100 μg/liter) had no effect upon serum erythropoietin activity. This study demonstrates that induction of erythrocytosis in rats by intrarenal injection of αNi_3S_2 is mediated by increased serum erythropoietin activity.

5481 Ultrastructure of paraquat-treated slash pine (Pinus elliottii engelm.). Birchem, R.; Brown, C.L. (Univ. of Georgia, Athens). Contract EY-76-5-09-0888. *USAmerican Journal of Botany (U.S.);* **66**: No. 10, 1208-1218(1979).

The introduction of paraquat into the transpiration stream of young slash pine trees significantly enhances oleoresin biogenesis and results in localized resin soaking in treated portions of the bole. All affected cells of the xylem symplast, including those not directly assocated with resin ducts, begin to synthesize excessive oleoresin and secret or lose it initially through pits into the lumen of contiguous tracheids. Oleoresin is observed in plastids, mitochondrial envelopes, vacuoles, and ER cisternae in both control and treated trees. Cells near the site of paraquat treatment show extreme damage to membrane integrity, depletion of starch, and loss of cellular organization.

5482 Sister chromatid exchange: the most sensitive mammalian system for determining the effects of mutagenic carcinogens. Wolff, S. (Univ. of California, San Francisco). Contract EY-76-C-03-1012-370. pp 229-246 of Genetic damage in man caused by environmental agents. Berg, K. (ed.). New York, NY; Academic Press, Inc. (1979).

It appears that the induction of sister chromatid exchanges (SCEs) by mutagenic carcinogens provides a very sensitive cytogenetic test for the observations of the effects of these compounds on DNA. The induction of SCEs, particularly in xeroderma pigmentosum cells, occurs at very low concentrations, far lower than those at which effects can be noticed in mammalian systems with more ordinary mutagenic and cytological tests. The SCE tests have the advantage of being very quick. For instance, CHO cells can be seeded into flasks on one day, treated on the next, and fixed 24 hours later. The cells can be quickly stained and scored. Since such a large number of SCEs is induced per chromosome, statistically significant results can be obtained when only 20 cells are scored, as contrasted to the tedious lengthy scoring required to observe significant differences with ordinary chromosome aberrations. This chapter discusses the use of SCEs for determining the effects of mutagenic carcinogens.

5483 Carcinogen-induced damage to DNA. Strauss, B.; Altamirano, M.; Bose, K.; Sklar, R.; Tatsumi, K. (Univ. of Chicago, IL). pp 229-250 of Carcinogens: identification and mechanisms of action. Griffin, A.C.; Shaw, C.R. (eds.). New York, NY; Raven Press (1979).

Human cells respond to carcinogen-induced damage in their DNA in at least two ways. The first response, excision repair, proceeds by at least three variations, depending on the nature of the damage. Nucleotide excision results in relatively large repair patches but few free DNA breaks, since the endonuclease step is limiting. Apurinic repair is characterized by the appearance of numerous

breaks in the DNA and by short repair patches. The pathways behave as though they function independently. Lymphoic cells derived from a xeroderma pigmentosum complementation group C patient are deficient in their ability to perform nucleotide excision and also to excise 6 methoxyguanine adducts, but they are apurinic repair competent. Organisms may bypass damage in their DNA. Lymphoblastoid cells, including those derived from xeroderma pigmentosum treated with ^{3}H-anti-BPDE, can replicate their DNA at low doses of carcinogen. Unexcised ^{3}H is found in the light or parental strand of the resulting hybrid DNA when replication occurs in medium with BrdUrd. This observation indicates a bypass reaction occurring by a mechanism involving branch migration at DNA growing points. Branch migration in DNA preparations have been observed, but the evidence is that most occurs in BrdUrd-containing DNA during cell lysis. The measurement of the bifilarly substituted DNA resulting from branch migration is a convenient method of estimating the proportion of new synthesis remaining in the vicinity of the DNA growing point. Treatment with carcinogens or caffeine results in accumulation of DNA growing points accompanied by the synthesis of shortened pieces of daughter DNA.

5484 **Serum ceruloplasmin concentrations in rats with primary and transplanted sarcomas induced by nickel subsulfide.** Sunderman, F.W. Jr.; Trudeau, E.A. Jr.; Horak, E.; Mitchell, J.M.; Allpass, P.R. (Univ. of Connecticut, Farmington). Contract EY-76-S-02-3140. *USAnnals of Clinical Laboratory Science (U.S.);* **9**: No. 1, 60-67(1979).

Ceruloplasmin (CPN) concentrations were measured by p-phenylenediamine oxidase assay in serums from (a) 30 control Ficher rats; (b) 5 rats with primary sarcomas induced by i.m. injection of nickel subsulfide (αNi_3S_2), and (c) 12 rats at intervals up to six weeks after s.c. transplantation of four αNi_3S_2-induced sarcomas. Serum CPN concentrations were not significantly increased in rats with primary sarcomas (mean = 0.38 g per liter) (S.D. +- 0.05), versus 0.35 g per liter (S.D. +- 0.04) in controls. In contrast, serum CPN concentratins were increased witin 11 to 21 days in all rats with transplanted sarcomas. Maximum concentrations of serum CPN occurred at 31 to 34 days after tumor transplantation, (mean = 0.56 +- 0.05 g per liter), equivalent to 1.6 +- 0.2 times the initial CPN concentrations in serums obtained prior to treatment ($P < 0.001$). The development of hyperceruloplasminemia in rats with transplanted sarcomas and not in rats with primary sarcomas is attributed to greatly enhanced growth-rates of the transplanted neoplasms.

5485 **Relationship between DNA alkylation and specific-locus mutation induction by N-methyl- and N-ethyl-N-nitrosourea in cultured Chinese hamster ovary cells (CHO/HGPRT system).** Thielmann, H.W. (Institut fuer Biochemie, Heidelberg, Germany); Schroeder, C.H.; O'Neill, J.P.; Brimer, P.A.; Hsie, A.W. Contract W-7405-ENG-26. *NLChemico-Biological Interactions (Netherlands);* **26**: 233-243(1979).

Chinese hamster ovary (CHO) cells in culture were utilized to determine the cytotoxicity, specific-locus mutation induction, and DNA alkylation which result from treatment of the cells with a range of concentrations of N-methyl-N-nitrosourea (MNU) or N-ethyl-N-nitrosourea (ENU). Mutation induction at the hypoxanthine-guanine phosphoribosyl transferase (HGPRT) locus was quantified by determination of the frequency of resistance to 6-thioguanine under stringently-defined selection conditions. The mutation frequency increased linearly with MNU or ENU concentration (0.01 to 2.0 mM). At equal levels of DNA alkylation, ENU was found to be approx. 4.5 times as mutagenic as MNU.

5604 Other Environmental Pollutant Effects

5486 **Electrical wiring configurations and childhood cancer.** Mille, M.W. (Univ. of Rochester, NY). *USAmerican Journal of Epidemiology (U.S.);* **112**: 165-167(1980).

A causal relationship between the induction of childhood cancer and home exposure to transmission line magnetic fields has been suggested by other authors. The reason for their suggestion is the overrepresentation of childhood cancer cases in high current configuration (HCC) relative to a control distribution of homes near high current and low current configuration (LCC) transmission lines (TL). The author of this letter and the editor estimate the magnetic field exposure at addresses considered in HCC and LC areas and suggests that the 60 Hz magnetic fields in all residences were dominated by ambient household fields.

57 HEALTH AND SAFETY

5487 **Consideration of the wider impact of present trends in radiation protection systems.** Thompson, R.C. (Biology Dept., Pacific Northwest Lab., Richland, WA, USA). pp 629-635 of Application of the dose limitation system for radiation protection. Practical implications. Proceedings of a topical seminar on the practical implications of the ICRP recommendations (1977) and the revised IAEA basic standards for radiation protection sponsored by IAEA, ILO, WHO, OECD NEA, ICRP. Vienna, Austria; IAEA (1979).

From Topical seminar on the practical implications of the ICRP recommendations (1977) and the revised IAEA basic standards for radiation protection; Vienna, Austria (5 - 9 Mar 1979).

It is argued that the radiation protection system provided by ICRP-26, while an admirable scientific hypothesis, has serious shortcomings as an effective regulatory document. Particularly vulnerable to attack is the emphasis on our ability to estimate health risks associated with established exposure limits, and our ability to interpret these risks in terms of what society considers acceptable. The emphasis on intake limits rather than deposition limits for internally deposited radionuclides, and the complexity of the dosimetric approach in deriving these limits, are also critized. It is recommended that national or international bodies employing these recommendations should provide more extensive justification of the limits, based on considerations other than health risk estimates, and that derived limits should be included that will enhance the practical applicability of the system.

5488 **(UCID—18006(Rev.1)) Lawrence Livermore Laboratory's beryllium control program for high-explosive test firing bunkers and tables.** Johnson, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Nov 1980. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01.

This report on the control program to minimize beryllium levels in Laboratory workplaces includes an outline of beryllium surface, soil, and air levels and an 11-y summary of sampling results from two high-use, high-explosive test firing bunkers. These sampling data and other studies demonstrate that the beryllium control program is functioning effectively.

5489 **(UCID—18833) Review of ARAC's involvement in the Titan II missile accident.** Sullivan, T.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Oct 1980. Contract W-7405-ENG-48. 44p. NTIS, PC A03/MF A01.

The Atmospheric Release Advisory Capability (ARAC) response to the Titan II accident near Damascus, Arkansas on 19 September 1980 entailed 12 personnel for periods ranging from 2 to 12 hours. The first call was a NEST Standby alert at 0415L (PCT), followed by a request for dispersal calculations at 0615L, personnel callout at 0630L, crude estimates of plausible source term scenarios at 0845-0900L, first model calculations at 1130L and final model calculations at 1500L. While several new firsts were recorded for ARAC, demonstrating expanded capabilities for NEST-type responses, time lines were very long, essential information was very scant to non-existent, and useful communication of final calculations to the accident site impossible. A detailed chronology is found in Appendix A and a list of acronyms and abbreviations is contained in Appendix B.

5490 **(UCRL—52982) Service life of respirator cartridges at various concentrations of common organic solvents.** Nelson, G.O.; Carlson, G.J.; Johnson, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 May 1980. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01.

A series of tests was conducted to determine the service life of respirator cartridges for 20 commonly-used laboratory solvents. These solvents were tested at 1, 5, and 10 times the Threshold Limit Value (TLV) concentrations. The results conformed to the

Freundlich isotherm and compared favorably to breakthrough times calculated from the adsorption isotherm and modified Wheeler equation. Cartridge life for solvents at concentrations other than those tested can be estimated from the constants which were derived from the experimental data.

58 GEOSCIENCES

5801 Geology And Hydrology

5491 (RHO-BWI-C—83) Bibliography of the geology of the Columbia Plateau and adjacent areas of Oregon. (Shannon and Wilson, Inc., Seattle, WA (USA)). Aug 1980. Contract AC06-77RL01030. 129p. NTIS, PC A07/MF A01.

This bibliography was prepared under contract with Rockwell Hanford Operations' Basalt Waste Isolation Program. The objective of the Basalt Waste Isolation Program is to determine the feasibility of storing nuclear waste within the Columbia River Basalt Group. Under the geologic portion of this program, the stratigraphic, structural, tectonic, seismic, and hydrologic aspects of the Columbia Plateau are being examined. This supplement covers 1978, 1979, and early 1980 publications, as well as some items published prior to 1978. Every effort was made to avoid duplicating citations already listed in the basic bibliography.

5492 (UCID—18688) Site characterization: a spatial estimation approach. Candy, J.V.; Mao, N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1980. Contract W-7405-ENG-48. 124p. NTIS, PC A06/MF A01.

In this report the application of spatial estimation techniques or kriging to groundwater aquifers and geological borehole data is considered. The adequacy of these techniques to reliably develop contour maps from various data sets is investigated. The estimator is developed theoretically in a simplified fashion using vector-matrix calculus. The practice of spatial estimation is discussed and the estimator is then applied to two groundwater aquifer systems and used also to investigate geological formations from borehole data. It is shown that the estimator can provide reasonable results when designed properly.

5493 (USGS-OFR—80-569) Paleohydrology of the southern Great Basin, with special reference to water table fluctuations beneath the Nevada Test Site during the Late Pleistocene. Winograd, I.J.; Doty, G.C. (Geological Survey, Reston, VA (USA)). 1980. Contract AI08-78ET44802. 98p. NTIS, PC A05/MF A01.

The magnitude of water table rise during Pleistocene pluvial climates, and of the resultant shortening of ground-water flow path and reduction in unsaturated zone thickness, is investigated. The distribution of calcitic veins in alluvium and lakebeds, and of tufa deposits, between the Ash Meadows spring discharge area and the Nevada Test Site suggests that discharge from the regional Paleozoic carbonate aquifer during the Late Pleistocene occurred at distances as much as 14 kilometers northeast of Ash Meadows and at altitudes up to 50 meters higher than at present. Use of the underflow equation (relating discharge to transmissivity, aquifer width, and hydraulic gradient), and various assumptions regarding pluvial recharge, transmissivity, and altitude of ground-water base level, suggest possible rises in potentiometric level in the carbonate aquifer of 6 to 90 meters beneath central Frenchman Flat, 58 kilometers northeast of Ash Meadows. During Wisconsin time the rise probably did not exceed 30 meters. Water-level rises beneath Frenchman Flat during future pluvials are unlikely to exceed 30 meters, and future levels might even be 10 meters lower than the modern one, 210 meters beneath the center of the valley. Neither the cited rise in potentiometric level in the regional carbonate aquifer, nor the shortened flow path during the Late Pleistocene precludes utilization of the NTS as a repository for high-level or transuranic-element radioactive wastes provided other requisite conditions are met at this site. Deep water tables, attendant thick (up to several hundred meter) unsaturated zones, and ground-water flow paths tens of kilometers in length characterized the region during Wisconsin time and possibly throughout the Pleistocene, and are likely to so characterize it during future pluvial climates.

5802 Geophysics

5494 (PB—80-170996) Guide for hydrogeologists. Volume II. Maksimov, V.M. (Bureau of Reclamation, Washington, DC (USA)). [nd]. Translation of Spravochnoe Rukovodstvo Gidrogeologa. Tom II, Leningrad, 1967. 549p. NTIS, PC A23/MF A01.

Partial contents include: hydrogeological survey; method of describing the water points and hydrogeological observations in the boreholes, profiles, wells and underground structures; laboratory methods and empirical formulas for determining the filtration coefficient of rocks; a short description of the hydrogeochemical methods of prospecting of minerals; methods of hydrogeological studies for water supply, explorations and prospecting of oil and gas, disposal of industrial waste waters in deep horizons and hydrotechnical structure; drilling equipments, pumps and motors for drilling the hydrogeological boreholes.

5803 Mineralogy, Petrology, And Rock Mechanics

5495 (DOE/ER/70224—T3) Correlation of permeability, velocity, strain and crack spectra for a suite of seven LASL rock samples. Interim report: partial data compilation. Warren, N. (California Univ., Los Angeles (USA)). Sep 1980. Contract AT03-76ER70224. 169p. NTIS, PC A08/MF A01.

Compressional and shear velocities, static strain, and permeabilities were measured for a suite of 7 rocks from LASL. The sample included two gneisses (cored parallel and perpendicular to the plane of foliation), a diorite, a granite, two quartzites and a marble. This interim report is a partial compilation of data, presented simply as a useable inventory and as a reference source of data for other studies in the future. The import of this data set is that for each sample it consists of measurements of four physical properties all of which are controlled by the sample's microstructure. Therefore, the sets of data for any one rock are expected to show strong cross-correlations, and to provide insight into the inverse problem of predicting physical properties from petrostructural models.

5496 (DOE/ER/70224—T4) Crack spectra analysis. Tiernan, M. (California Univ., Los Angeles (USA)). Sep 1980. Contract AT03-76ER70224. 25p. NTIS, PC A02/MF A01.

Crack spectra derived from velocity data have been shown to exhibit systematics which reflect microstructural and textural differences between samples (Warren and Tiernan, 1980). Further research into both properties and information content of crack spectra have yielded the following: Spectral features are reproducible even at low pressures; certain observed spectral features may correspond to non-in-situ crack populations created during sample retrieval; the functional form of a crack spectra may be diagnostic of the sample's grain texture; hysteresis is observed in crack spectra between up and down pressure runs - it may be due to friction between the faces of closed crack populations.

5497 (DOE/ER/70224—T5) Quantitative petrostructure analysis. Technical summary report. Warren, N. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics). Sep 1980. Contract AT03-76ER70224. 36p. NTIS, PC A03/MF A01.

The establishment of quantitative techniques would lead to the development of predictive tools which would be of obvious importance in applied geophysics and engineering. In rock physics, it would help establish laws for averaging the effects of finite densities of real cracks and pores. It would also help in elucidating the relation between observed complex crack structures and various models for the mechanical properties of single cracks. The petrostructure study is addressed to this problem. The purpose of the effort is to quantitatively characterize the mineral and crack texture of granitic rock samples. The rock structures are to be characterized in such a way that the results can be used (1) to constrain the modelling of the effect of cracks on the physical properties of rocks, and (2) to test the possibility of establishing quantitative and predictive relations between petrographic observables and whole rock properties. Statistical techniques are being developed and

being applied to the problem of parameterizing complex texture and crack patterns of rock, and of measuring correlation of these parameters to other measurable variables. The study is an application in factor analysis.

5498 **(SAND—80-1434) Quasi-static and creep data for dome salt from Bryan Mound, Texas.** Wawersik, W.R.; Holcomb, D.J.; Hannum, D.W.; Lauson, H.S. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01.

Experiments are described for quasi-static loading conditions and for creep at zero, 500 (3.5) and 2000 (13.8 MPa) psi confining pressure and at 22 and 60°C. All quasi-static test results were consistent with data from other sources including unconfined and triaxial compressive strengths, ultimate strains, secant moduli during first laboratory loading and elastic constants. In contrast, creep of Bryan Mound salt was anomalous in that the observed creep rates were one to two orders of magnitude smaller than the typical creep rates of other rock salt of similar purity subjected to the same conditions of stress and temperature. No temperature effect was resolved on creep of Bryan Mound salt within the scatter of the data. Comparative data for triaxial compression and extension suggest reductions in the failure strains and changes in the failure modes with increasing intermediate principal stress. These effects are attributed to differences in microfracture networks. Microfracturing was observed optically and indirectly by measuring acoustic emissions. The acoustic emissions correlated directly with the magnitude of the observed volumetric strain.

5499 **(UCID—18853) Transient two-dimensional flow in porous media.** Sharpe, L. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Sep 1979. Contract W-7405-ENG-48. 43p. NTIS, PC A03/MF A01.

The transient flow of an isothermal ideal gas from the cavity formed by an underground nuclear explosion is investigated. A two-dimensional finite element method is used in analyzing the gas flow. Numerical results of the pressure distribution are obtained for both the stemming column and the surrounding porous media.

5500 **(UCID—18862) Ultrasonic velocities and strength of Frenchman's Flat alluvium.** Costantino, M.S.; Bonner, B.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01.

Compressional and shear wave speeds and longitudinal stress and strain were measured under undrained triaxial stress for Frenchman's Flat alluvium. Nine of the thirteen samples were tested in as-received conditions and four were re-constituted in various ways. No difference in the measured properties of the virgin and reconstituted samples was found. Maximum shear stresses less than 0.1 MPa were observed at longitudinal strains up to 7 to 10% in the fully saturated samples at a confining pressure of about 10 MPa. Further increase in longitudinal strain resulted in a dramatic increase in the maximum shear stress to values greater than 3 MPa. This increase in strength is a result of an increase in effective stress as the sample dilates and the pore fluid pressure decreases. Sound speeds for compressional (v/sub p/) and shear (v/sub s/) waves increased dramatically during hydrostatic loading, then remained constant under triaxial loading to more than 10% axial strain. Under triaxial loading conditions, v/sub p/ ranged between 1.77 and 2.48 km/sec with an average v/sub p/ = 2.18 +- 0.23 km/sec. v/sub s/ ranged from 0.74 to 1.02 km/sec with v/sub s/ = 0.90 +- 0.10 km/sec. The ratio v/sub p//v/sub s/, taken for each sample, ranged from 1.82 to 2.71 with v/sub p//v/sub s/ = 2.39 +- 0.30. No significant changes in v/sub p/ and v/sub s/ were observed in the dilatant region.

5501 **(UCRL—52978) Enthalpy (H/sub T/-H_{298}) of anhydrous silicate melts from 1520 to 2600°K.** Stout, N.D.; Piwinskii, A.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1980. Contract W-7405-ENG-48. 59p. NTIS, PC A04/MF A01.

As an aid to modeling the behavior of melted rock at high temperatures, we measured the enthalpy, H/sub T/-H_{298}, of anhydrous melts of six silicate rock samples and three silicate minerals for values of temperature T from 1520 to 2600°K. The rock samples were basalt, tuff, rhyolite, and desert alluvium from the Department of Energy's Nevada Test Site. The minerals were SiO_2, $CaSiO_3$, and $CaMgSi_2O_6$. We observed a slight compositional dependence of enthalpy for the rock melts. Relative values of enthalpy above 1600°K are as follows: enthalpy of basalt > enthalpy of rhyolite > enthalpy of tuff. The measured enthalpies of the molten $CaSiO_3$ and $CaMgSi_2O_6$ are significantly higher than enthalpies calculated from additivity relations assuming solid oxide components. Since we cannot predict the behavior of high-temperature silicate liquids from the known behavior (at lower temperatures) of their solid components, we need to acquire more high-temperature experimental data on silicate liquids as a basis for realistic modeling of melted rock behavior.

5502 **(USGS-OFR—80-1098) Compilation of results of three-dimensional stress determinations made in Rainier and Aqueduct Mesas, Nevada Test Site, Nevada.** Ellis, W.L.; Magner, J.E. (Geological Survey, Denver, CO (USA)). 1980. Contract AI08-76DP00474. 31p. NTIS, PC A03/MF A01.

Since 1971, the US Bureau of Mines overcore method has been used to determine the state of stress at nine locations within Rainier and Aqueduct Mesas at the Nevada Test Site, Nevada. Results of these determinations indicate a generally consistent pattern of relatively high stress in a northeast-southwest direction and relatively low stress in a northwest-southeast direction within the mesas. The pattern is consistent with estimates of the regional stress orientation based on geologic and geophysical evidence, including earthquake focal-plane solutions. The state of stress in Rainier and Aqueduct Mesas is probably mostly tectonic in origin, with significant modifications in stress magnitude and orientation owing to the topography of the mesas, their location above the average regional elevation, and influence of local geologic features at individual measurement locations.

5804 Geochemistry

5503 **Effect of dissolution of volcanic glass on the water chemistry in a tuffaceous aquifer, Rainier Mesa, Nevada.** White, A.F.; Claassen, H.C.; Benson, L.V. Washington, DC; Department of the Interior (1980). 38p. GPO.

Geochemistry of ground water associated with the Tertiary tuffs with in Rainier Mesa, southern Nevada, was investigated to determine the relative importance of glass dissolution in controlling water chemistry. Water samples were obtained both from interstitial pores in core sections and from free-flowing fractures. Cation compositions showed that calcium and magnesium decreased as a function of depth in the mesa, as sodium increased. The maximum effect occurs within alteration zones containing clinoptilolite and montmorillonite, suggesting these minerals effectively remove bivalent cations from the system. Comparisons are made between compositions of ground waters found within Rainier Mesa that apparently have not reacted with secondary minerals and compositions of waters produced by experimental dissolution of vitric and crystalline tuffs which comprise the principal aquifers in the area. Comparison of mass-transfer rates of the vitric and crystalline tuffs indicates that the apparent higher glass-surface to aqueous-volume ratio associated with the vitric rocks may account for dominance of the glass reaction.

5805 Oceanography

5504 **(HIG—80-5) Mean annual variation of sea level in the Pacific Ocean.** Wyrtki, K.; Leslie, W.G. (Hawaii Univ., Honolulu (USA). Hawaii Inst. of Geophysics). Aug 1980. 164p. National Science Foundation, Washington, DC.

The mean annual variation of sea level in the Pacific Ocean is documented on the basis of sea level records from 169 stations along the continental margins and on islands. The results are displayed in numerical and graphical form. The data were also subjected to a harmonic analysis to determine the amplitudes and phases of the annual and semi-annual variations. The distribution of the harmonic parameters and of some derived quantities are charted and discussed.

64 PHYSICS RESEARCH

6401 Astrophysics And Cosmology

5505 **(LA-UR—80-2810) Two-dimensional radiation-hydrodynamics calculations of the formation of O-B association in dense molecular clouds.** Klein, R.I.; Sandford, M.T.; Whitaker, R.W. (California Univ., Berkeley (USA); Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-800872—8). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

Two-dimensional calculations of ionization-shockwave propagation into a curved molecular cloud are presented. Density enhancement occurs due to the combined effects of cloud curvature and radiation flow. The star formation process is expected to be enhanced near the edges of irregularly shaped molecular clouds.

5506 **(LA-UR—80-2814) RR Lyrae and BL Herculis variables.** Cox, A.N. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-800872—14). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

The RR Lyrae variables are currently believed to have masses between about 0.5 and 0.8 M/sub solar mass/, effective surface temperatures between 6350 and 7500°K, radii from about 4.0 to 6.0 R/sub solar mass/ and luminosities between log L/L/sub solar mass/ of 1.5 and 2.0. Since they are found in population II locations, they generally have $Y = 0.3$ and $Z = 10^{-3}$, but there are exceptions for both higher Z like the sun and lower Z like 0.0002. In globular clusters the periods range from 0.25 to 0.45 day for the first overtone pulsators and 0.40 to 0.80 day for those in the fundamental mode, depending on their luminosity. At transition lines, discussed in detail, the switch from fundamental to first overtone, or maybe vice versa, involves a period change factor of about 0.74 to 0.75.

5507 **(LA-UR—80-2815) Light and velocity curve bumps for BW Vulpeculae.** Pesnell, W.D.; Cox, A.N. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800872—15). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

Bumps in the light and radial velocity curves of the Beta Cephei star BW Vulpeculae were modeled. Two mechanisms, a resonance phenomena and non-linear pulsations, were investigated. The resonance condition was clearly not fulfilled, the calculated period ratio being approximately 0.60, where a value of 0.50 L +- 0.03 is required for resonance. In the non-linear calculation, the bump appears, with the correct phase, but was found at an amplitude that is too large. Further, the light curve does not show any bump-like feature. The cause of the bump is the large spurious boost given the star's velocity field by the solution methods. The calculated periods of the stellar models are shorter than those of previous calculations, enhancing the possibility that these stars pulsate in a radial fundamental mode.

5508 **(LA-UR—80-2816) Low-mass evolution from HE ignition to beyond the horizontal branch.** Despain, K. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800872—9). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

The evolution of an 0.6 M/sub solar mass/ stellar model during core helium burning is presented. Following the off-center ignition of helium in the core flash, the star remains on the red giant branch for $> 10^6$ years, undergoing twelve additional flashes. After leaving the giant branch, the star evolves on the horizontal branch for 8.15×10^7 years before returning to the giant branch and undergoing strong helium-shell flashes. The implications for horizontal branch and RR Lyrae stars are discussed.

5509 **(LA-UR—80-2818) Linear and nonlinear pulsation of β Cephei stars.** Cox, A.N.; Hodson, S.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800872—11). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

Data from the β Cephei variable α Virginis is used to see if the pulsations can be caused by mixing of hydrogen and helium in the semiconvective zone. (GHT)

5510 **(LA-UR—80-2871) One dimensional hydrodynamics of asteroid-neutron star collisions.** Newman, M.J.; Cox, A.N. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800872—12). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

Results are presented of simplified one-dimensional hydrodynamic-radiation diffusion calculations of the tidal breakup of a solid body approaching a neutron star in central impact. (GHT)

5511 **(LA-UR—80-3231) Supernova explosions: the role of a Rayleigh-Taylor instability.** Buchler, J.R.; Livio, M.; Colgate, S.A. (Florida Univ., Gainesville (USA). Dept. of Physics; Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy; Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-800872—18). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

A two dimensional hydrodynamic study indicates that convectively unstable gradients which develop during core collapse and bounce give rise to large scale core overturn. It is also shown that the concomitant release of neutrinos can deposit large amounts of energy and momentum in the infalling envelope and give rise to a powerful supernova explosion.

5512 **(LA-UR—80-3232) Pulsations of the R Coronae Borealis stars.** Cox, J.P.; King, D.S.; Cox, A.N.; Wheeler, J.C.; Hansen, C.J.; Hodson, S.W. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA); Colorado Univ., Boulder (USA); National Bureau of Standards, Boulder, CO (USA); New Mexico Univ., Albuquerque (USA); Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800872—17). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

The radial pulsations of very luminous, low-mass models ($L/M \sim 10^4$, solar units), which are possible representatives of the R CrB stars, have been examined. These pulsations are extremely nonadiabatic. There are in some cases at least one extra (strange) mode which makes interpretation difficult. The blue instability edges are also peculiar, in that there is an abrupt excursion of the blue edge to the blue for L/M sufficiently large. The range of periods of the model encompasses observed periods of the Cepheid-like pulsations of actual R CrB stars.

5513 **(UCRL—85121) Type I supernova models vs observations.** Weaver, T.A.; Axelrod, T.S.; Woosley, S.E. (California Univ., Livermore (USA). Lawrence Livermore National Lab.; California Univ., Santa Cruz (USA). Lick Observatory). 3 Nov 1980. Contract W-7405-ENG-48. 46p. (CONF-8003?0—3). NTIS, PC A03/MF A01.

From Supernova type I workshop; Austin, TX, USA (17 Mar 1980).

This paper explores tHe observational consequences of models for Type I supernovae based on the detonation (or deflagration) of the degenerate cores of white dwarfs or intermediate mass (≃ 9 M/sub sun/) stars. Such nuclear burning can be initiated either at the center of the core or near its edge. The model examined in most detail is that of a 0.5M/sub sun/ C/O white dwarf which undergoes an edge-lit He/C/O detonation after accreting 0.62 M/sub sun/ of he at 10^{-8} M/sub sun//yr. The light curve resulting from this model is found to be in excellent agreement with those observed for Type I supernovae, particularly those in the fast subclass. The physical processes involved in the detailed numerical cal-

culations which lead to this conclusion are quantitatively elucidated by simple analytic models, and effects of uncertainties in the input physics are explored.

6402 Atmospheric Physics

5514 (BDX—613-2531) Microprocessors as a tool in determining correlation between sferics and tornado genesis: an update. Witte, D.R. (Bendix Corp., Kansas City, MO (USA)). Sep 1980. Contract AC04-76DP00613. 23p. (CONF-8010136—1). NTIS, PC A02/MF A01.

From MAECON '80 - a new decade in electronics; Kansas City, MO, USA (14 Oct 1980).

Sferics - atmospheric electromagnetic radiation - can be directly correlated, it is believed, to the genesis of tornadoes and other severe weather. Sferics are generated by lightning and other atmospheric disturbances that are not yet entirely understood. The recording and analysis of the patterns in which sferics events occur, it is hoped, will lead to accurate real-time prediction of tornadoes and other severe weather. Collection of the tremendous amount of sferics data generated by one storm system becomes cumbersome when correlation between at least two stations is necessary for triangulation. Microprocessor-based computing systems have made the task of data collection and manipulation inexpensive and manageable. The original paper on this subject delivered at MAECON '78 dealt with hardware interfacing. Presented were hardware and software tradeoffs, as well as design and construction techniques to yield a cost effective system. This updated paper presents an overview of where the data comes from, how it is collected, and some current manipulation and interpretation techniques used.

6403 Atomic, Molecular, And Chemical Physics

5515 (CONF-801111—25) Photodetachment cross sections for $He^-(^4P^0)$. Compton, R.N.; Alton, G.D.; Pegg, D.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

The first measurements are reported of photodetachment cross sections for He^- (formed through charge exchange of He^+ with Ca vapor) over the photon energy range from 1.77 to 2.75 eV. The energies of autodetached electrons from the metastable He^- beam have also been determined for the first time. The autodetached electron energy agrees within experimental error (+-0.25 eV) with the known $1s2s2p)^4P^0$ He^- energy level. This taken with measurements for the lifetime of He^- infers that charge exchange of He^+ with Ca vapor produces $^4P^0$ He^-.

5516 (CONF-801111—27) Nonstatistical theory of multiple vacancy production in atomic collisions. Becker, R.L.; Reading, J.F.; Ford, A.L. (Oak Ridge National Lab., TN (USA); Texas A and M Univ., College Station (USA). Dept. of Physics). 1980. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

Till now interpretation of x-ray satellite data has been limited to the use of models in which the emissions of electrons are treated as statistically independent. This assumption leads to a product of binomial distributions, one for each shell. However, even in the independent Fermi particle model of the target atom, collision theory predicts that the holes are correlated. At a given impact parameter the independent-Fermi-particle probability for producing several holes in a given shell can be written as a term containing only probabilities for the individual vacancies, which reduces for average holes to the binomial distribution, plus a correlation term which involves interference among amplitudes for the single-electron transitions. Expressions for the general case are given. To evaluate such expressions, one needs calculations in which the single-electron amplitudes are obtained with consistent relative phases. These have now begun by employing coupled-channels theory.

5517 (DOE/ER/05056—1) Progress report. (Howard Univ., Washington, DC (USA)). 1980. Contract AS05-76ER05056. 11p. NTIS, PC A02/MF A01.

CN radicals produced in the collisions C + NO and C + N_2O were studied by laser-induced spectroscopy. Effects of an excimer laser on a CS_2 beam were also observed. The work performed is only summarized here; completed work has been published. (RWR)

5518 (DOE/ER/10618—1) Theoretical studies of atomic transitions. Progress report, March 15, 1980-March 14, 1981. Fischer, C.F. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Computer Science). 1981. Contract AS05-80ER10618. 12p. NTIS, PC A02/MF A01.

Theoretical calculations of energy levels and studies of transition probability trends have been performed for several cases. In complex systems where plunging configurations are presented in the isoelectronic sequence, irregularities are known to occur in the region where energy levels of interacting configurations cross. In theoretical studies it is customary to draw a continuous curve for the line integral value trend. Through a study of a model problem it was shown that continuity of the trend is maintained only when plotted for a transition from the j/sup th/ to the k/sup th/ level rather than from a state with a given dominant component to one with another dominant component. In order for beam-foil experimentalists to obtain reliable line integral value data, a knowledge of important cascade corrections is needed. The simulation study performed by Younger and Wiese suggested that the yrast cascade dominated. A study of lifetime patterns in the Al I sequence where the discrepancy between theory and experiment is much smaller for the lowest ^2D state ($3s3p^2$ except for Al I) than the second lowest ^2D state ($3s^23d$ except for Al I) has indicated the importance of the degeneracy set, that in this case the direct cascade from $3s3p(^1P)3d^2F$ may be more important than the yrast chain. At present at least three experimental line integral values have been reported to four significant digits with error limits of at most 0.7%. The first two are for resonance transitions of Li I and II, the third for Na I. Preliminary evaluations based on existing results and additional MCHF calculations suggested the results are not quite as accurate as predicted.

5519 Pionic and muonic atoms. Shera, E.B. (Los Alamos Scientific Lab., NM (USA)). *NLNuclear Physics, A (Netherlands);* **335**: No. 1/2, 75-82(Feb 1980).

From 8. international conference on high energy physics and nuclear structure with the kaon workshop (ICOHEPANS-8); Vancouver, Canada (13 - 17 Aug 1979).

The field of pionic and muonic atom research is reviewed with emphasis on papers contributed to the 8th International Conference on High Energy Physics and Nuclear Structure.

5520 Adsorption and fluorescence spectra of rare earth ions in solution. Chapter 24. Carnall, W.T. (Argonne National Lab., IL (USA)). pp 171-208 of Handbook on the physics and chemistry of rare earths. Volume 3. Non-metallic compounds - I. Gschneider, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). Amsterdam, Netherlands; North-Holland (1979).

The author discusses the theoretical and experimental investigations on the absorption and fluorescence spectra of rare earth ions in aqueous solution.

5521 (LA-UR—80-3180) Photodetachment of relativistic ions. Donahue, J.B.; Gram, P.A.M.; Hamm, M.E.; Hamm, R.W.; Bryant, H.C.; Butterfield, K.B.; Clark, D.A.; Frost, C.A.; Smith, W.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801111—9). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

A series of fundamental laser ion beam experiments has been made feasible by the high-quality, relativistic (β = 0.842) H^- ion beam available at the Clinton P. Anderson Meson Physics Facility (LAMPF). The relativistic Doppler shift of the light from an ordinary ultraviolet laser provides what is, in effect, a continuously tunable vacuum-ultraviolet laser in the rest frame of the moving ions.

The Lorentz transformation of a modest laboratory magnetic field provides an electric field of several megavolts/centimeter. The latest results of photo-detachment work with H^- beams and our spectroscopic work with H^0 beams are presented. Plans for future work are discussed.

5522 **(LA-UR—80-3252) Pulse-probe measurements in low-temperature, low-pressure SF_6.** Lyman, J.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 12p. (CONF-8006137—1). NTIS, PC A02/MF A01.

From Molecular structure and energy scrambling workshop; Bielfeld, F.R. Germany (23 Jun 1980).

To improve understanding of multiple-photon absorption by polyatomic molecules, we have performed a series of experiments wherein a pulsed CO_2 laser irradiated 0.02 to 0.08 torr samples of SF_6 at 145°K. A cw probe laser monitored the time response of the induced absorption of transmission at many CO_2 laser lines that are in or near the ν_3 absorption of SF_6. The experiments covered a 40-fold fluence range and probe times out to 4 ms. The absorbed laser radiation produces a nonthermal vibrational-energy distribution and that intermolecular vibrational-energy transfer is important at early times in redistributing the absorbed energy. The influence of other processes on the induced spectrum is discussed.

5523 **Photodissociation of CH^+ through absorption into shape resonances of the A ^{1}PI state.** Uzer, T.; Dalgarno, A. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA). Contract EY-76-S-02-2887. *NLChemical Physics Letters (Netherlands);* **63**: No. 1, 22-24(1 May 1979).

The locations and widths of shape resonances of the A ^{1}PI state of CH^+ are calculated together with the absorption oscillator strengths for absorption into those resonances which predissociate. The photodissociation cross sections through the two broadest resonances are calculated. 2 figures, 1 table.

5524 **Photodissociation of Na_2i.** Uzer, T.; Dalgarno, A. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA). Contract EY-76-S-02-2887. *NLChemical Physics Letters (Netherlands);* **61**: No. 2, 213-215(15 Feb 1979).

Calculations are presented of the effective cross sections for the photodissociation of Na_2^+ ions in vibrational levels populated by absorption from the B ^{1}PI/sub u/ state of Na_2. 2 figures, 1 table.

5525 **Nonradiative processes of rare earth ions in crystals. Chapter 36.** Fong, F.K. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). pp 317-339 of Handbook on the physics and chemistry of rare earths. Volume 4. Nonmetallic compounds - II. Gschneider, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). Amsterdam, Netherlands; North-Holland (1979).

The author discusses recent developments in the treatment of two broad classes of nonradiative phenomena: electron-lattice relaxation processes in which the electronic excitation within a single ion is dissipated into the vibrational modes of the host lattice; and energy transfer processes that result in the transmittance of the excitation energy from one rare earth ion to another. The adiabatic theory of multiphonon transitions is outlined and its various applications in the analysis of experimental observations are described.

5526 **Characterization of high temperature vapors and gases.** Hastie, J.W. (ed.). Washington, D.C.; National Bureau of Standards (1979). 819p. (NBS-SP—561(Vol.1); CONF-780941—(Vol.1)). $20.00.

From 10. materials research symposium; Gaithersburg, MD, USA (18 Sep 1978).

Abstracts of 29 items from volume one of the symposium were prepared separately for the data base. (GHT)

5527 **Characterization of high temperature vapors and gases.** Hastie, J.W. (ed.). Washington, DC; National Bureau of Standards (1979). 939p. (NBS-SP—561(Vol.2); CONF-780941—(Vol.2)). $20.00.

From 10. materials research symposium; Gaithersburg, MD, USA (18 Sep 1978).

Volume 2 contains 45 papers presented in sessions on spectroscopic diagnostic techniques - species concentration and temperature measurement, rate processes in gases - homogeneous systems and heterogeneous systems, and thermodynamic data and applications. Fifteen papers were abstracted separately.

5528 **Cars diagnostic investigations of flames.** Eckbreth, A.C.; Hall, R.J. (United Technologies Research Center, East Hartford, CT). *USNational Bureau of Standards (U.S.), Special Publication (U.S.);* **2**: No. 561, 943-972(1979). (NBS-SP—561(Vol.2); CONF-780941—(Vol.2)).

From 10. materials research symposium; Gaithersburg, MD, USA (18 Sep 1978).

Coherent anti-Stokes Raman spectroscopy (CARS) investigations in a variety of flames are presented. Thermometry has received the primary emphasis in the research to be reported, but some species sensitivity studies will be described as well. CARS is generated by mixing a 10 pps, frequency-doubled neodymium pump laser with a spectrally broadband, laser-pumped, Stokes dye laser. This approach obviates the requirement to frequency scan the dye laser and generates the entire CARS spectrum with each pulse permitting instantaneous measurements of medium properties. A crossed-beam, phase-matching technique termed BOXCARS is described which leads to greatly enhanced and unambiguous spatial resolution in contrast to the conventionlly employed collinear phase-matching approaches.

6404 Magnetohydrodynamics

5529 **Diagnostic techniques in combustion MHD flows.** Self, S.A. (Stanford Univ., CA). Contract EX 76-C-01-2341. *USNational Bureau of Standards (U.S.), Special Publication (U.S.);* **2**: No. 561, 915-941(1979). (NBS-SP—561(Vol.2); CONF-780941—(Vol.2)).

From 10. materials research symposium; Gaithersburg, MD, USA (18 Sep 1978).

The US national program in MHD electric power generation is predicated on the direct firing of pulverized coal, using MHD as a topping cycle for a regular steam plant. Extensive system studies predict the thermal efficiency of a large combined MHD/Steam plant will be in the range 50 to 55% compared with 35 to 40% for a conventional steam plant. The major features of an MHD power generation system are briefly outlined, and the important problem areas identified. This is followed by a discussion of those aspects related primarily to the characterization of the combustion products plasma as they affect generator performance. The sub-scale MHD facility at Stanford is briefly described, and the principal areas of the past and ongoing research program outlined. A major focus of this work is understanding the detailed magneto-plasma mechanics of the generator channel flow. A vital component of the program is the developement and use of advanced diagnostic techniques for determining the plasma and flow properties inside an operating generator channel. These techniques are described. It goes without saying that the extreme conditions and hostile environment pose a considerable challenge to most measurement methods.

6451 Particle Interactions And Properties - Experimental

5530 **(CONF-800724—52) Current and target jets produced in high energy neutrino-deuterium interactions.** Kitagaki, T.; Tanaka, S.; Yuta, H. (Tohoku Univ., Sendai (Japan); Illinois Inst. of Tech., Chicago (USA); Maryland Univ., College Park (USA); State Univ. of New York, Stony Brook (USA); Tufts Univ., Medford, MA (USA)). 1980. Contract AC02-76ER03023. 18p. NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

In an analysis of approx. 7000 charged-current ν-deuterium interactions from an exposure of the Fermilab 15-foot bubble chamber to a wide band neutrino beam, the single quark jet (current fragments) was observed to have a wider spread in P/sub t/ than that from the recoiling diquark jet (target fragments) for $W > 9$ GeV. This result suggests an effect of gluon emission from the single quark. 6 figures, 1 table.

5531 **New particles observed in e^+e^- annihilation.** Goldhaber, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 390-412 of Weak interactions. Proceedings of the International School of Physics 'Enrico Fermi' Course 71 held at Varenna, Italy, 11 - 23 July 1977. Baldo Ceolin, M. (ed.). Amsterdam, Netherlands; North-Holland (1979).

From International School of Physics 'Enrico Fermi' Course 71 on weak interactions; Varenna, Italy (11 - 23 Jul 1977).

The author discusses what has been learned about the 'new' particles primarily from colliding e^+e^- machines.

5532 **(DOE/ER/02232—92) Measurement of the transverse momenta of partons and of jet fragmentation as a function of $\sqrt{s}$ in p-p collisions: CCOR Collaboration.** Besch, H.J.; Camilleri, L.; del Papa, C. (European Organization for Nuclear Research, Geneva (Switzerland); Columbia Univ., New York (USA); Oxford Univ. (UK); Rockefeller Univ., New York (USA)). 1980. Contract AC02-76ER02232. 7p. (CONF-800724—58(Summ.)). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

A large solid-angle apparatus consisting of a superconducting solenoid magnet, cylindrical drift chambers, and two arrays of lead-glass counters was used to examine particles associated with a high-transverse momentum trigger in p-p collisions with three $\sqrt{s}$ values at the CERN ISR. The trigger was given by energy deposition in lead-glass arrays centered at 90°. The trigger transverse momentum range covered was 3 < p/sub Ttrig/ < 11 GeV/c. Results are given for p/sub out/ for both individual charged particles and the sum of charged particle momenta in the hemisphere opposite to the trigger. Mean values are then deduced for the parton transverse momentum, k/sub T/, and for the jet fragmentation momentum, j/sub T/. Results of a jet analysis are also presented. 6 figures.

5533 **(DOE/ER/02232—94) Study of direct single photons and correlated particles in proton-proton collisions at $\sqrt{s}$ = 62.4 GeV (CCOR collaboration).** Besch, H.J.; Camilleri, L.; del Papa, C. (Rockefeller Univ., New York (USA); European Organization for Nuclear Research, Geneva (Switzerland); Columbia Univ., New York (USA); Oxford Univ. (UK)). 1980. Contract AC02-76ER02232. 4p. (CONF-800724—59). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Invariant cross sections for direct single photon production were measured with thresholds of 3, 5, 7, and 9 GeV/c in p/sub T/. The fraction γ/all of single-photon events in the data sample is plotted. The +/- charge ratio in the hemisphere opposite the trigger was determined for single-γ and π^0-type events. 4 figures. (RWR)

5534 **Parity violation in deep inelastic electron scattering.** Taylor, R.E. (Stanford Univ., CA (USA). Stanford Linear Accelerator Center). pp 468-483 of Nuclear physics with electromagnetic interactions. Proceedings. Arenhoevel, H.; Drechsel, D. (eds.). Berlin, Germany, F.R.; Springer (1979).

From International conference on nuclear physics with electromagnetic interactions; Mainz, F.R. Germany (5 Jun 1979).

Only a couple of years ago it has been proved experimentally that in the scattering of electrons by protons the interaction interferes with the coulomb scattering and non-conservation of parity appears. The experimental possibilities using polarized electron beams are reviewed and future experiments are suggested. Model predictions are compared with experimental results.

5535 **Charmed meson produced in e^+e^- annihilation.** Goldhaber, G. (California Univ., Berkeley (USA). Dept. of Physics). pp 413-446 of Weak interactions. Proceedings of the International School of Physics 'Enrico Fermi' Course 71 held at Varenna, Italy, 11-23 July 1977. Baldo Ceolin, M. (ed.). Amsterdam, Netherlands; North-Holland (1979).

From International School of Physics 'Enrico Fermi' Course 71 on weak interactions; Varenna, Italy (11 - 23 Jul 1977).

The data discussed are from two experiments at SPEAR. A narrow resonance of mass 1865 MeV/c^2 was observed. Evidence is presented that this new particle - and its associated excited state - can be identified with the (D^0, D^+) and (D^{*0}, D^{*+}) doublets of charm theory.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 5534, 5539

5536 **(BNL—28630) Quark flavor mixing and its physical implications.** Wang, L.L.C. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 7p. (CONF-800724—60). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Developments on the subject of flavor mixing, especially the Kobayashi-Maskawa model, since the Tokyo conference in 1978 are reviewed. Aspects discussed include the following: history of the development of the understanding of weak interaction quark states, the determination of the mixing matrix V, nonleptonic decays (the $\Delta I = 1/2$ rule of K decays, charm nonleptonic decays), the neutron electric dipole moment, decay interference from CP violation, dynamical origin of the quark flavor mixing, and alternatives to the three doublet model. 34 references, 1 figure. (RWR)

5537 **(BNL—28671) Neutrino mass as the probe of intermediate mass scales.** Senjanovic, G. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 20p. (CONF-8010127—4). NTIS, PC A02/MF A01.

From Neutrino mass mini-conference; Cable, WI, USA (1 Oct 1980).

A discussion of the calculability of neutrino mass is presented. The possibility of neutrinos being either Dirac or Majorana particles is analyzed in detail. Arguments are offered in favor of the Majorana case: the smallness of neutrino mass is linked to the maximality of parity violation in weak interactions. It is shown how the measured value of neutrino mass would probe the existence of an intermediate mass scale, presumably in the TeV region, at which parity is supposed to become a good symmetry. Experimental consequences of the proposed scheme are discussed, in particular the neutrino-less double β decay, where observation would provide a crucial test of the model, and rare muon decays such as $\mu \rightarrow e\gamma$ and $\mu \rightarrow$ ee anti e. Finally, the embedding of this model in an O(10) grand unified theory is analyzed, with the emphasis on the implications for intermediate mass scales that it offers. It is concluded that the proposed scheme provides a distinct and testable alternative for understanding the smallness of neutrino mass. 4 figures.

6454 Field Theory

5538 **Infrared behavior of the effective coupling in quantum chromodynamics: A non-perturbative approach.** Bar-Gadda, U. (Stanford Linear Accelerator Center, CA (USA)). *NLNuclear Physics, B (Netherlands);* **163**: No. 3, 312-322(Feb 1980).

In this paper we examine a different viewpoint, based on a self-consistent approach. This means that rather than attempting to identify any particular physical mechanism as dominating the QCD vacuum state we use the non-perturbative Schwinger-Dyson equations and Slavnov-Taylor identities of QCD as well as the renormalization group equation to obtain the self-consistent behavior of the effective coupling in the infrared region. We show that the infrared effective coupling behavior g-bar(q^2/μ^2, g/sub R/(μ)) = (μ^2/q^2/sup lambda/2/g/sub R/(μ) in the infrared limit $q^2/\mu^2 \rightarrow 0$, where μ^2 is the euclidean subtraction point; lambda = 1/2(d - 2), where d is the space-time dimension, is the preferred solution if a sufficient self-consistency condition is satisfied. Finally we briefly discuss the nature of the dynamical mass Λ and the 1/N expansion as well as an effective bound state equation.

5539 **(BNL—28595) QCD, unification and the road to asymptopia.** Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA)). Nov 1980. Contract AC02-76CH00016. 19p. NTIS, PC A02/MF A01.

Attempts to describe interactions at extremely high energies are addressed. Previous beliefs that asymptopia - the theoretically promised land where all asymptotic theorems come true - was reached have always proven false. Present estimates of asymptopia range from 10^5 GeV to 10^{16} GeV. In the author's opinion it is premature to believe that the universe is described by a hierarchy of nested gauge groups. The establishment of QCD as the nonabelian gauge group describing strong interactions has not yet been accomplished. 2 figures. (RWR)

5540 **Axial currents, supercurrents and anomalies in supersymmetric QED.** Clark, T.E. (Los Alamos Scientific Lab., NM (USA)). pp 237-244 of Supergravity. Proceedings of the Supergravity Workshop held at Stony Brook, 27 - 29 September, 1979. Nieuwenhuizen, P. van; Freedman, D.Z. (eds.) (State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics). Amsterdam, Netherlands; North-Holland (1979).

From Supergravity workshop; Stony Brook, NY, USA (26 Sep 1979).

The currents associated with the superconformal asymmetries are defined as moments of the supercurrent, V/sub μ/. All of the current (non-) conservation equations are known once the generalized trace of the supercurrent is found. The superconformal anomalies are shown to have coefficients given by β of the Callan-Symanzik equation. In super QED there is an additional U(1) axial current whose anomaly has a coefficient with no radiative corrections.

65 PHYSICS RESEARCH

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 5565, 5568

6512 Nuclear Properties And Reactions, A=1-5, Experimental

5541 **(CONF-8010138—2) Future investigations in electromagnetic nuclear physics.** Hadjimichael, E. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Theoretical Physics; Fairfield Univ., CT (USA). Dept. of Physics). 1980. Contract AC02-76ER03069. 17p. NTIS, PC A02/MF A01.

From Symposium on perspectives on electro and photonuclear physics; Saclay, France (Oct 1980).

Some basic problems in nuclear physics that may receive positive response from electro- and photonuclear research are discussed. Future directions for this research are outlined, and some specific experimental proposals compiled by a study group under the sponsorship of the Bates (MIT) Users Group are described. 1 table.

6512 Nuclear Properties And Reactions, A=1-5, Theoretical

5542 **Elastic electron scattering at large momentum transfer.** Arnold, R.G. (American Univ., Washington, DC; Stanford Univ., CA (USA). Stanford Linear Accelerator Center). pp 76-87 of Nuclear physics with electromagnetic interactions. Proceedings. Arenhoevel, H.; Drechsel, D. (eds.). Berlin, Germany, F.R.; Springer (1979).

From International conference on nuclear physics with electromagnetic interactions; Mainz, F.R. Germany (5 Jun 1979).

A review is given of elastic electron scattering at large momentum transfer ($Q^2 > 20$ fm^{-2}) from nuclei with A =< 4. Recent experimental results are reviewed and the current problems in our interpretation of these results are pointed out. Some questions for future experiments are posed, and a preview of possible future measurements is presented.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

5543 **(DOE/ER/02853—15) Nuclear scattering studies by the scattering of medium-energy electrons. Progress report, October 1, 1979-September 30, 1980.** Peterson, G.A. (Massachusetts Univ., Amherst (USA). Dept. of Physics and Astronomy). Oct 1980. Contract AS02-76ER02853. 27p. NTIS, PC A03/MF A01.

Electron scattering experiments are in progress at the Bates Linear Accelerator in Middleton, Massachusetts. Both magnetic elastic and transverse inelastic scattering cross sections have been measured at 180° by the apparatus constructed and brought into operation in late 1977 by the University of Massachusetts. Coulomb contributions to the scattering have been measured at forward angles. Scattering from the ground-state magnetization distributions of ^{13}C, ^{15}N, and ^{27}Al have been measured out to a momentum transfer of 3.2 fm^{-1}. Only the M1 multipole enters for the ^{13}C and ^{15}N, whereas M1, M3, and M5 are present for ^{27}Al. Measurements of the transverse form factors of the excited states of ^{13}C have been completed. Information on M4 stretched-spin cases and on transverse excitations have been obtained for the first time. The study of particle-hole stretched spin (g/sub 9/2/f/sub 7/2/$^{-1}$) M8 excitations in /sup 54,56/Fe and /sup 58,60/Ni is continuing. Comparison with hadron excitation to these states yields information on the hadron-nucleus interaction. A search for M1 excitations in ^{208}Pb at energies up to 26 MeV at beam energies of 30, 40, 50, 60, and 75 MeV has been completed in collaboration with Oak Ridge National Laboratory. A liquid-nitrogen cooled deuterium target cell is being constructed for use in a study of the electrodisintegration of the deuteron. An ^{15}N gas target cell was constructed, and the measurement of inelastic excitations is nearly completed. 8 figures.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

5544 **Analysis of neutrons emitted from 14 MeV neutron induced reactions.** Pearlstein, S. (Brookhaven National Lab., Upton, NY (USA)). pp 1059-1065 of Compte rendu d'une conference internationale sur la physique neutronique et les donnees nucleaires pour les reacteurs et autres applications. Harwell, 25-29 Sep 1978. Paris, France; OECD (1978).

From Conference on neutron physics and other applied purposes; Harwell, UK (25 Sep 1978).

The neutron emission spectra from reactions in structural materials bombarded by energetic nucleons are important in the analysis of fission and fusion systems and accelerator-based applications. Measured neutron emission spectra from 14 MeV neutron induced reactions are analyzed by precompound nuclear reaction theory using the nuclear model code ALICE. Sensitivity procedures are used to determine optimal global fitting parameters. A single set of input nuclear constants produces agreement of calculated spectra to within 30% of experimental values in over 70% of the cases. The fitting parameters, their co-variances, and their correlations are discussed.

5545 **(PB—80-170467) Radiative capture of polarized neutrons in ^{51}V and ^{141}Pr nuclei. Master's thesis.** de Haas, J.B.M. (Netherlands Energy Research Foundation, Petten). Dec 1979. 77p. NTIS, PC A05/MF A01.

Experiments and results on circular polarization and angular distribution of primary neutron capture gamma rays from vanadium and praseodymium nuclei are described. Experiments were performed at the 45-MW high-flux reactor in Petten.

6516 Nuclear Properties And Reactions, A=59-89,

Experimental

5546 **Neutron capture cross sections for unstable nuclei in the mass 90 region derived from proton capture measurements.** Gardner, D.G.; Dietrich, F.S.; Heikkinen, D.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp 1126-1130 of Compte rendu d'une conference internationale sur la physique neutronique et les donnees nucleaires pour les reacteurs et autres applications. Harwell, 25-29 Sep 1978. Paris, France; OECD (1978).

From Conference on neutron physics and other applied purposes; Harwell, UK (25 Sep 1978).

Experimental measurements have been made of the production cross sections and energy distributions of gamma rays emitted when the stable targets ^{88}Sr, ^{89}Y and ^{90}Zr are exposed to protons in the energy range 3-8 MeV. The data are being analyzed using a recent version of the Uhl statistical model code. One conclusion is that while the gamma-ray strength functions employed here reproduce the proton capture cross sections, they do not achieve the same degree of hardness observed in the measured spectra. To do so, their lower energy regions must be modified; such changes, however, do not affect the capture cross sections.

6517 Nuclear Properties And Reactions, A=90-149, Theoretical

5547 **(LA-UR—80-3368) Nuclear double beta decay and the evidence for lepton number non-conservation.** Stephenson, G.J. Jr. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-8010127—3). NTIS, PC A02/MF A01.

From Neutrino mass mini-conference; Cable, WI, USA (1 Oct 1980).

The reported ratio of double beta decay of the isotopes ^{128}Te and ^{130}Te measured by geochemical techniques, coupled with an assumed equality of the nuclear matrix elements, would indicate the existence of a neutrinoless branch indicative of lepton number violation. A large-scale shell model calculation of the nuclear matrix elements was performed; they were found to be approximately equal. However, the absolute rates calculated for the normal, two-neutrino branch alone are 49 times faster than experiment for ^{128}Te and 156 times faster than experiment for ^{130}Te. In a similar vein, a rate that is 18 times faster than the geochemical result is calculated for the transition ^{82}Se → ^{82}Kr; however, that calculation is in essential agreement with a recent counting experiment. It is argued that, until these large discrepancies are resolved, one cannot say anything definitive about lepton number violation, although the possibility that the ratio of rates is indicating a positive signal remains. It is also noted that, for the case of ^{76}Ge → ^{76}Se, a pure Majorana mass of 35 eV is ruled out by Fiorini's limit on neutrinoless double beta decay. 3 tables.

5548 **Calculated neutron capture cross sections for the ground states and isomers of ^{93}Nb, ^{94}Nb, ^{95}Nb.** Gardner, M.A.; Gardner, D.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp 1121-1125 of Compte rendu d'une conference internationale sur la physique neutronique et les donnees nucleaires pour les reacteurs et autres applications. Harwell, 25-29 Sep 1978. Paris, France; OECD (1978).

From Conference on neutron physics and other applied purposes; Harwell, UK (25 Sep 1978).

Neutron-induced capture cross sections for the ground states and first isomeric states of ^{93}Nb, ^{94}Nb and ^{95}Nb have been studied from the resolved resonance region to 4 MeV via statistical model calculations. The production of isomers has been included. Inelastic scattering cross sections and gamma-ray production spectra were also calculated. The GAMMAγ/D ratios were derived from gamma-ray strength function systematics. Total capture cross sections on the ground states are found to be within a factor of two of each other. Capture cross sections on the isomeric targets are important as well not only because of their magnitude but also because of the significant population of these isomeric levels by inelastic scattering.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

5549 **(LA-UR—80-3279) Nuclear orientation studies of rare-earth metals.** Krane, K.S.; Morgan, G.L.; Moses, J.D. (Los Alamos Scientific Lab., NM (USA); Oregon State Univ., Corvallis (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800766—3). NTIS, PC A02/MF A01.

From 5. international conference on hyperfine interactions; Berlin, F.R. Germany (21 Jul 1980).

The angular distributions of gamma rays from /sup 166m/Ho and ^{160}Tb aligned at low temperatures in, respectively, Ho metal and Tb metal have been measured. Large hyperfine splittings, expected for the rare earths, have been deduced from the temperature dependence of the gamma-ray anisotropies. Both samples show a macroscopic magnetic anisotropy that is not consistent with an interpretation in terms of a randomly oriented polycrystalline structure.

6520 Nuclear Properties And Reactions, A=220 And Above, Theoretical

5550 **(CONF-801107—39) Thermal neutron flux generation by high-energy protons in thick uranium targets.** Alsmiller, R.G. Jr.; Gabriel, T.A.; Barish, J.; Alsmiller, F.S. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The transport code, HETC, is used to calculate the transport of medium- and low-energy nucleons and pions through fissionable material. One of the purposes of such calculations is to aid in the design of an intense source of low-energy neutrons from medium-energy protons bombarding uranium targets. The transport code incorporates a revised cross section model so that medium-energy pion and nucleon transport calculations in fissionable material may be carried out. (GHT)

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

5551 **Measurements of (n,3n) cross sections for ^{235}U and ^{238}U.** Veeser, L.R.; Arthur, E.D. (Los Alamos Scientific Lab., NM (USA)). pp 1054-1058 of Compte rendu d'une conference internationale sur la physique neutronique et les donnees nucleaires pour les reacteurs et autres applications. Harwell, 25-29 Sep 1978. Paris, France; OECD (1978).

From Conference on neutron physics and other applied purposes; Harwell, UK (25 Sep 1978).

We have measured cross sections for the ^{235}U(n,3n) reaction from 14.8 to 21 MeV, for ^{238}U(n,2n) from 14.7 to 19 MeV, and for ^{238}U(n,3n) from 14.7 to 22 MeV with ^{3}H(d,n) neutrons and a large liquid scintillator tank, and we have calculated (n,xn) and fission cross sections from 4 to 22 MeV for both nuclei using a statistical, preequilibrium model. We have also calculated the individual spectra of the two (n,2n) and three (n,3n) neutrons.

6520 Nuclear Properties And Reactions, A=220 And Above, Theoretical

5552 **Subcritical limits for special fissile actinides.** Clark, H.K. (Savannah River Lab., Aiken, SC). *USNuclear Technology (U. S.)Supersedes Nuclear Applications and Technology;* **48**: No. 2, 164-170(Apr 1980).

Critical masses and subcritical mass limits in oxide-water mixtures were calculated for actinide nuclides other than ^{233}U, ^{235}U, and ^{239}Pu that have an odd number of neutrons in the nucleus: S/sub n/ transport theory was used together with cross sections, drawn from the GLASS multigroup library, developed to provide accurate forecasts of actinide production at Savannah River. The subcritical limits are 201 g for ^{241}Pu, 13 g for ^{242}/sup m/Am, 90 g for ^{243}Cm, 30 g for ^{245}Cm, 900 g for ^{247}Cm, 10 g for ^{249}Cf, and 5 g for ^{251}Cf. Association of ^{241}Pu with an equal mass of ^{240}Pu increases the ^{241}Pu limit to a value greater than that for pure

^{239}Pu. Association of ^{242}/sup m/Am with ^{241}Am increases the limit for the mixture to that for dry, theoretical density AmO_2 at isotopic concentrations of ^{242}/sup m/Am less than ~ 6%. Association of ^{245}Cm with ^{244}Cm increases the limit according to the formula 30 + 0.3 ^{244}Cm/^{245}Cm up to the limit for dry CmO_2. A limiting mass of 8.15 kg for plutonium containing at least 67% ^{238}Pu as oxide was calculated that applies (provided ^{240}Pu exceeds ^{241}Pu) with no limit on moderation. 1 figure, 5 tables.

6530 Nuclear Theory

5553 **(BNL—28451) Evaluations of average level spacings.** Liou, H.I. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 34p. (CONF-800979—11). NTIS MF A01.

From Workshop on nuclear data evaluation methods and procedures; Upton, NY, USA (22 Sep 1980).

Portions of document are illegible.

The average level spacing for highly excited nuclei is a key parameter in cross section formulas based on statistical nuclear models, and also plays an important role in determining many physics quantities. Various methods to evaluate average level spacings are reviewed. Because of the finite experimental resolution, to detect a complete sequence of levels without mixing other parities is extremely difficult, if not totally impossible. Most methods derive the average level spacings by applying a fit, with different degrees of generality, to the truncated Porter-Thomas distribution for reduced neutron widths. A method that tests both distributions of level widths and positions is discussed extensivey with an example of ^{168}Er data. 19 figures, 2 tables.

5554 **(DOE/ER/13001—24) Nuclear theory group progress report and renewal proposal, December 1, 1980-November 30, 1981.** Brown, G.E.; Jackson, A.D.; Kuo, T.T.S. (State Univ. of New York, Albany (USA). Research Foundation). 1980. Contract AS02-76ER13001. 135p. NTIS, PC A07/MF A01.

This report covers a broad range of topics in theoretical nuclear physics, intermediate energy physics, and nuclear astrophysics. Primary emphasis is placed on understanding the nature of the nucleon-nucleon and meson-nucleon interactions and on related questions regarding the structure of baryons. A number of these questions are addressed with the aid of the chiral bag model. Starting from the free interaction, many-body techniques are used to construct the effective interaction between nucleons in nuclei and nuclear media and optical potentials for the description of the scattering of nucleons by nuclei. A wide range of nuclear phenomena are amenable to analysis using such effective interactions. Among the most interesting are nuclear giant resonances, for which are offered both new semiclassical insight and a new dynamical theory of nuclear vibrations that emphasizes the importance of the energy dependence of the effective interaction. The extension of Jastrow/hypernetted chain techniques and a better understanding of their content has led to a better description of the ground-state correlations in nuclear matter and a variety of other condensed systems. The equation of state of nuclear matter at densities of astrophysical interest is discussed. It is possible to understand the properties of pulsars given the interactions between their constituents. A description of pulsar formation and of the effects of the shock wave generated in the collapse of large stars is given. Heavy-ion reactions, quasimolecular states, and energy dissipation are studied through the excitation of collective excitations within a semiclassical framework. Items in this report are of the nature of extended abstracts. References to complete papers are given.

5555 **Mesonic and relativistic effects in the nuclear electromagnetic interaction.** Friar, J.L. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). pp 445-456 of Nuclear physics with electromagnetic interactions. Proceedings. Arenhoevel, H.; Drechsel, D. (eds.). Berlin, Germany, F.R.; Springer (1979).

From International conference on nuclear physics with electromagnetic interactions; Mainz, F.R. Germany (5 Jun 1979).

The subject of mesonic effects in nuclei may be subdivided into effects which are basically nonrelativistic and those which are of relativistic order. Ambiguities existing in relativistic theories complicate calculations. It is discussed how they are tractable. Furthermore, it is investigated whether there is any evidence of relativistic exchange currents in nuclear physics.

5556 **(LBL—11436) Nuclear states and shapes at high spin.** Diamond, R.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 93p. (CONF-8009118—1). NTIS, PC A05/MF A01.

From 12. summer school in nuclear physics; Mikotaki, Poland (1 Sep 1980).

As angular momentum is added to a nucleus, the balance of forces acting upon it to determine its shape, moment of inertia, mode of rotation, and type of level structure may undergo a series of changes. At relatively low spins a deformed nucleus will rotate collectively, and one may see the effect of Coriolis antipairing in gradually increasing the moment of inertia. Around spin 12 to 16 h-bar there may be an abrupt change (backbending) when a pair of high-j nucleons unpairs and the nucleons align with the axis of rotation; this process allows the nucleus to slow its collective rotation. This process, the start of a sharing of angular momentum between single-particle motion and the collective rotation, gives a lower total energy and corresponds to a change toward triaxiality in the shape of the nucleus. At much higher spins discrete γ-ray transitions can no longer be observed. This is the regime of continuum spectra; all the information on these high-spin states (to 65 h-bar) is contained in these continuum cascades. Knowledge is accumulating on how to study these spectra, experimentally and theoretically, and new techniques offer promise of revealing a great deal of information about the shapes and properties of very high spin states. 71 references, 34 figures.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 5550

5557 **(BNL—28607) Relativistic rise measurements with very fine sampling intervals.** Ludlam, T.; Platner, E.D.; Polychronakos, V.A.; Lindenbaum, S.J.; Kramer, M.A.; Teramoto, Y. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA)). 1980. Contract AC02-76CH00016. 15p. (CONF-801103—33). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The motivation of this work was to determine whether the technique of charged particle identification via the relativistic rise in the ionization loss can be significantly improved by virtue of very small sampling intervals. A fast-sampling ADC and a longitudinal drift geometry were used to provide a large number of samples from a single drift chamber gap, achieving sampling intervals roughly 10 times smaller than any previous study. A single layer drift chamber was used, and tracks of 1 meter length were simulated by combining together samples from many identified particles in this detector. These data were used to study the resolving power for particle identification as a function of sample size, averaging technique, and the number of discrimination levels (ADC bits) used for pulse height measurements.

5558 **(CONF-801124—30(Draft)) Pulsed-laser annealing of ion-implanted GaAs: theory and experiment.** Wood, R.F.; Lowndes, D.H.; Christie, W.H. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

It is shown that, in the pulsed-laser irradiation of crystalline or lightly damaged GaAs, good agreement is obtained between measured and calculated thresholds for melting, for catastrophic damage due to vaporization, and for the duration of surface melting at various energy densities. Good agreement between theory and experiment is also obtained for dopant profile spreading during pulsed-laser annealing.

5559 **(CONF-801124—32(Draft)) Leed investigation of (111) oriented Si, Ge and GaAs surfaces following pulsed laser irradiation.** Zehner, D.M.; Noonan, J.R.; Davis, H.L.; White, C.W.; Ownby, G.W. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

The low energy electron diffraction (LEED) patterns obtained from clean (111) oriented Si, Ge, and GaAs single crystals subsequent to their irradiation with the output of a pulsed ruby laser in an ultra-high vacuum (UHV) environment suggest that metastable (1 x 1) surface structures are produced in the regrowth process. Conventional LEED analyses of the Si and Ge surfaces suggest that they terminate in registry with the bulk but that the two outermost interlayer spacings differ from those of the bulk. For the case of Si these changes are a contraction of 25.5 +- 2.5% and an expansion of 3.2 +- 1.5% between the first and second and second and third layers, respectively.

5560 **(LA—8536-MS) Theory of contributon transport.** Painter, J.W.; Gerstl, S.A.W.; Pomraning, G.C. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 52p. NTIS, PC A04/MF A01.

A general discussion of the physics of contributon transport is presented. To facilitate this discussion, a Boltzmann-like transport equation for contributons is obtained, and special contributon cross sections are defined. However, the main goal of this study is to identify contributon transport equations and investigate possible deterministic solution techniques. Four approaches to the deterministic solution of the contributon transport problem are investigated. These approaches are an attempt to exploit certain attractive properties of the contributon flux, psi = phi phi$^+$, where phi and phi$^+$ are the solutions to the forward and adjoint Boltzmann transport equations.

5561 **(LA-UR—80-3260) Intense electron-beam propagation in low-density gases using PHERMEX.** Moir, D.C.; Newberger, B.S.; Thode, L.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 32p. (CONF-8010128—1). NTIS, PC A03/MF A01.

From JOWOG 6 conference; Albuquerque, NM, USA (7 Oct 1980).

Preliminary propagation experiments have been performed using the LASL-PHERMEX 21-MeV electron beam with current densities of 40 kA/cm^2. Gas densities are varied from 10-m torr to 580 torr. Results indicate the presence of microinstabilities.

5562 **(UCRL—50400(Vol.17)(Pt.D)) Program GROUPIE (version 79-1): calculation of Bondarenko self-shielded neutron cross sections and multiband parameters from data in the ENDF/B format.** Cullen, D.E. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 4 Jul 1980. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01.

Program GROUPIE reads evaluated data in the ENDF/B format and uses these data to calculate Bondarenko self-shielded cross sections and multiband parameters. To give as much generality as possible, the program allows the user to specify arbitrary energy groups and an arbitrary energy groups and an arbitrary energy-dependent neutron spectrum (weighing function). To guarantee the accuracy of the results, all integrals are performed analytically; in no case is iteration or any approximate form of integration used. The output from this program includes both listings and multiband parameters suitable for use either in a normal multigroup transport calculation or in a multiband transport calculation. A listing of the source deck is available on request.

6550 Medical Physics

5563 (COO—4733-3, pp 23-26) **Microdosimetry of x- and γ- rays in a water phantom.** Kliauga, P.; Varma, M.N.; Baum, J.W. (Brookhaven National Lab., Upton, NY). Jul 1980.

In Radiation physics, biophysics and radiation biology. Progress report for October 1, 1979-September 30, 1980.

The purpose of the measurements described here is to determine to what degree the microscopic distribution of ionization varies as a function of depth in a water phantom when irradiated with a monoenergetic beam of photons.

5564 **Heavy ion beam model for radiobiology.** Roth, R.A.; Katz, R. (Univ. of Nebraska, Lincoln). *USRadiation Research (U.S.);* **83**: No. 3, 499-510(Sep 1980).

An ad hoc model of energetic heavy ion beams, including secondary and tertiary particles, has been constructed for predicting radiobiological experiments. While the beam model is relatively primitive, it yields depth-dose and depth-radiobiological calculations in good agreement with experiment upstream of the Bragg peak. Beyond the peak the model is somewhat coarse grained and seems to underestimate low-LET fragment production. These defects can be repaired at some cost in computer time. Presently a complete set of depth-dose and radiobiological results (RBE, OER, aerobic and hypoxic survival) is obtained in 4 to 8 min, for a single beam, at a cost of $10. The model can be extended to mixed radiation fields, or to explore the design of ridge filters. These predictions are based on cellular radiosensitivity parameters extracted from track-segment irradiations at about 8 MeV/amu. Their success implies that no new radiobiological results arise from irradiation with beams at 500 MeV/amu.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 5195, 5525, 5558

5565 **(BNL—51200) Brookhaven highlights, October 1978-September 1979.** (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract AC02-76CH00016. 162p. NTIS, PC A08/MF A01.

These highlights present an overview of the major research and development achievements at Brookhaven National Laboratory from October 1978 to September 1979. Specific areas covered include: accelerator and high energy physics programs; high energy physics research; the AGS and improvements to the AGS; neutral beam development; heavy ion fusion; superconducting power cables; ISABELLE storage rings; the BNL Tandem accelerator; heavy ion experiments at the Tandem; the High Flux Beam Reactor; medium energy physics; nuclear theory; atomic and applied physics; solid state physics; neutron scattering studies; x-ray scattering studies; solid state theory; defects and disorder in solids; surface physics; the National Synchrotron Light Source ; Chemistry Department; Biology Department; Medical Department; energy sciences; environmental sciences; energy technology programs; National Center for Analysis of Energy Systems; advanced reactor systems; nuclear safety; National Nuclear Data Center; nuclear materials safeguards; Applied Mathematics Department; and support activities. (GHT)

5566 **(DOE/ER/05489—T1) Transport and reaction on surfaces: a stochastic approach.** Shlesinger, M.F.; Landman, U. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 1979. Contract AS05-77ER05489. 28p. NTIS, PC A03/MF A01.

Migration in surface reactions and some aspects of certain diffusion-controlled reactions on surfaces are examined. Recent developments in the analysis of field ion microscopy diffusion experiments are reviewed with respect to particle and cluster motion on ideal and defective surfaces: Green's function with internal states method; mathematical formalism of random walks with internal states, dimer diffusion in 1D, and three-state dimer in 1D are discussed. Then a renormalized Green's function method for studying diffusion on defective lattices is explained. Next, the kinetics of unimolecular and bimolecular diffusion-controlled reactions on surfaces catalyzed by active sites is considered. Finally, a puzzle in heterogeneous catalysis is explained. The bimolecular reaction of the disproportionation of propylene on the surface of a catalyst is seen to have a reaction rate maximum as a function of temperature. However, thermodynamic inequalities that must be satisfied for a rate maximum to occur are violated by the experimental data. It is shown how the thermodynamic inequalities may be satisfied if multistate diffusion mechanisms are assumed. The unifying feature to

the treatment of these studies of diffusion and reaction on surfaces is a stochastic description by means of random walk lattice Green's function propagators. 3 figures. (RWR)

5567 (UCRL—84588) Study of fast shock-induced dissociation by computer molecular dynamics. Karo, A.M.; Hardy, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Nebraska Univ., Lincoln (USA). Behlen Lab. of Physics). 31 Oct 1980. Contract W-7405-ENG-48. 59p. (CONF-800714—3). NTIS, PC A04/MF A01.

From NATO advanced study institute on fast reactions in energetic systems; Ioannina, Greece (6 Jul 1980).

The passage of shock waves through both simple and complex materials was studied. Attention was devoted to the complex nature of shock interaction with imperfections, crystalline irregularities, and surfaces of the lattice where energetic fragments, from single atoms to clusters, can be spalled. 24 figures. (RWR)

5568 (TT—74-52000/05) Ukrainian Physics Journal. Lashkarev, V.E. (ed.). Translated by *SUUkrainskii Fizicheskii Zhurnal (Russian Edition) (Ukrainian S.S.R.)Issued in English translation as Ukr. Phys. J.;* **17**: No. 5, 801-995(May 1972). 202p. (AEC-tr—7411/5). NTIS, PC A10/MF A01.

A cover-to-cover translation into English of Vol. 17, No. 5 (May 1972) of the Ukrainian Physics Journal (Ukrainskii Fizicheskii Zhurnal) is provided. Many of the papers in this issue were on solid state physics and materials, but there were other articles on atomic and nuclear physics, plasma research, and accelerators. Articles in scope for NSA were processed from the original-language edition. (RWR)

5569 (DOE/ER/10583—1) Measurement of near neighbor separations of surface atoms. Cohen, P.I. (Minnesota Univ., Minneapolis (USA)). [nd]. Contract AC02-80ER10583. 21p. NTIS, PC A02/MF A01.

Two techniques are being developed to measure the nearest neighbor distances of atoms at the surfaces of solids. Both measures extended fine structure in the excitation probability of core level electrons which are excited by an incident electron beam. This is an important problem because the structures of most surface systems are as yet unknown, even though the location of surface atoms is the basis for any quantitative understanding of the chemistry and physics of surfaces and interfaces. These methods would allow any laboratory to make in situ determinations of surface structure in conjunction with most other laboratory probes of surfaces. Each of these two techniques has different advantages; further, the combination of the two will increase confidence in the results by reducing systematic error in the data analysis.

6561 Superconductivity

5570 (DOE/ER/10566—1) Progress report for the Department of Energy. Clapp, M.T. (Massachusetts Univ., Amherst (USA). Dept. of Mechanical Engineering). 1980. Contract AS02-80ER10566. 21p. NTIS, PC A02/MF A01.

Large doses of B and C (up to 25 at %) were implanted into Nb_3Al substrates. The experimentaly determined compositional profiles from Auger analysis agreed very well with theoretically predicted profiles. There was also no significant redistribution of the B and C after heat treatments up to 850°C. The high doses involved produced a very disordered surface layer. From reflection electron diffraction analysis it was ascertained that this layer recrystallized at 850°C. The samples were subjected to a variety of heat treatments and superconducting transition temperatures were measured. After the recrystallization anneals, transitions in the implanted layer were observed around 10 and 11°K. These are being related to structure and lattice parameter of the implanted layers. As is well known the T/sub c/ of A-15's is strongly dependent on lattice parameter. The smaller a_0 the higher the T/sub c/. A difference in a_0 of 0.5 percent can make a dramatic change in T/sub c/. T/sub c/'s are also very sensitive to the degree of order in A-15's. The high implantation doses used created a great deal of disorder. It was hoped that annealing removed the effect of this disorder on T/sub c/. However, it may be necessary to use a much more dramatic means of annealing, such as laser melting of the implanted layers. It has been found in ion implanted semiconductors that laser melting is a very effective way of removing the defects associated with radiation damage.

6570 Theoretical Physics

5571 (DOE/ER/03992—427) Geometry of wave electromagnetics. Sudarshan, E.C.G. (Texas Univ., Austin (USA). Dept. of Physics; Harvard Univ., Cambridge, MA (USA). Lyman Lab. of Physics). 27 Oct 1980. Contract AS05-76ER03992. 12p. NTIS, PC A02/MF A01.

A challenge to the commonly held view of light as a wave phenomenon is presented. An exact realization of light as generalized pencils or rays is constructed, with stress placed on using pencils of rays rather than single rays. Exact equations of motion are presented for the rays in the pencil, and these rays tend to travel in straight lines in empty space (not too near the edge of the beam). (GHT)

5572 (SAND—80-1284) Temperature in bodies heated by a constant disk heat source. Beck, J.V. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 153p. NTIS, PC A08/MF A01.

Solutions, tables, and graphs for the transient temperature distribution in bodies subjected to a disk source uniform in time and position are presented. The first geometry covered is that of a semi-infinite solid; there is a disk source of radius a at the surface, the remainder of which is insulated. The only other geometry explicitly covered is a semi-infinite cylinder with a circular heat source of radius a located at z=0 and r=0. The cylinder has a radius of b. From r=a to b at the end (z=0), the surface is insulated. Two boundary conditions at the circular surface at r=b are covered: (a) insulation and (b) constant temperature at the initial value. In the course of this research many untabulated integrals involving error functions and Bessel functions have been derived. 17 figures, 32 tables.

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 5568

7001 Plasma Research

5573 (CONF-801111—30) Production of high-Q ions by laser bombardment method. Phaneuf, R.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

The expanding plasma produced when an intense pulse of laser radiation is focused in vacuum onto a solid target has been used as a source of highly stripped ions for collision cross-section measurements. Usable fluxes of carbon nuclei at energies of a few hundred eV/charge have been obtained by irradiation of graphite with pulses of CO_2 laser radiation at a focused power density of 3 x 10^{10} W/cm^2. Bombardment of aluminum and iron targets at comparable power levels have yielded ions of maximum charges of 9 and 16, respectively. A time-of-flight apparatus has been constructed to utilize the laser source for measurement of electron capture cross sections for highly stripped ions in gases at energies in the few hundred eV/charge range. Apertures collimate an ion beam from the plasma blowoff, and an electrostatic analyzer selects ions from the expanding plasma which have the same energy per charge. The beam is directed through a gas target cell, charge analyzed once more by deceleration, and detected by a channel plate electron multiplier used in a current amplification mode. Electron capture cross sections have been measured for C/sup +q/ ions, q = 3, 4, 5 in H_2 at energies ranging from 150 to 1160 eV/charge.

5574 (COO—2218-159) User's guide for SLWDN9, a code for calculating flux-surfaced-averaging of alpha densities, currents, and heating in non-circular tokamaks. Hively, L.M.; Miley, G.M. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). Mar 1980. Contract AC02-76ET52040. 14p. NTIS, PC A02/MF A01.

The code calculates flux-surfaced-averaged values of alpha density, current, and electron/ion heating profiles in realistic, noncircular tokamak plasmas. The code is written in FORTRAN and execute on the CRAY-1 machine at the Magnetic Fusion Energy Computer Center.

5575 **(DOE/ET/53006—6) Extreme ultraviolet and soft x-ray diagnostics of high-temperature plasmas. Annual progress report.** Moos, H.W.; Armstrong, L. Jr. (Johns Hopkins Univ., Baltimore, MD (USA)). 1980. Contract AS02-76ET53006. 81p. NTIS, PC A05/MF A01.

The work performed from mid-January 1979 through 1980 is described. EUV diagnostic studies have been performed at the Alcator A and C Tokamaks, and on TMX. A toroidal asymmetry has been found in the low density phase of Alcator A. The confinement time of impurities has been measured on Alcator A. Impurity concentrations in the center cell of TMX have been studied using EUV spectroscopic techniques. A time resolving spectrograph with 1024 detector elements is essentially complete.

5576 **(DOE/ET/53051—12) Measurement of convective cell spectra and the resultant calculated vortex diffusion coefficient.** Ehrhardt, A.B.; Post, R.S. (Wisconsin Univ., Madison (USA)). Oct 1980. Contract AS02-76ET53051. 43p. NTIS, PC A03/MF A01.

The presence of convective cells in a purely poloidal field Levitated Octupole has been associated with diffusion that scales as D/sub v/ (T* proportional to T/n) /sup 1/2/, independent of B, where T* is an effective temperature, T* proportional to T. The electric field spectrum of the convective cells can be used to estimate the magnitude of T* and D/sub v/. The results are in reasonable agreement with previous measurements of cross-field transport, and agree qualitatively with theoretical models of vortex diffusion.

5577 **(LA—8324-MS) Temperature diagnostics using lithium-like satellites.** Datla, R.U.; Jones, L.A.; Thomson, D.B. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01.

A 60-kJ θ-pinch was operated at a filling pressure of 16 mtorr using a gas mixture of 2% neon and 98% helium. The resonance and intercombination lines from Ne IX and the Li-like satellites were observed with a Bragg crystal monochromator. The electron temperature of the plasma was deduced from the intensity ratios of the Ne IX resonance line and the dielectronic satellites using recent theoretical calculations. The temperature values ranged from 210 eV to 340 eV during the time of occurrence of these satellites. The temperature measured at 1.0 μs by laser scattering for a similar plasma condition was in close agreement with that obtained by the resonance line/satellite ratio. This lends confidence to use of the satellite technique for temperature measurements in other plasmas.

5578 **(LA—8495-MS) Influence of a vacuum region on the stability of a high-beta screw pinch.** Cayton, T.E. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01.

To ascertain the influence of a vacuum region on the stability of a high-β screw pinch, the stability properties of two confinement configurations are compared. Both configurations involve diffuse equilibrium profiles and a rigid, perfectly conducting cylindrical shell. In the first problem, perfectly conducting plasma extends to the rigid conducting wall; the plasma is extremely tenuous in the outer region of the pinch, however. In the second case, profiles identical to those of the first problem are chosen for the central portion of the pinch, but the outer tenuous plasma is replaced by a perfectly insulating vacuum region. The two configruations are found to be unstable for the same range of external parameter values; different modes are unstable in the two cases, however. Thus, the presence of a vacuum region does not affect the stability boundary of the pinch, but it does affect the nature of the unstable modes.

5579 **(LA-UR—80-3238) Physical properties of compact toroids generated by a coaxial source.** Henins, I.; Hoida, H.W.; Jarboe, T.R.; Linford, R.K.; Marshall, J.; McKenna, K.F.; Platts, D.A.; Sherwood, A.R. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801215—6). NTIS, PC A02/MF A01.

From 3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program; Los Alamos, NM, USA (2 Dec 1980).

In the CTX experiments we have been studying CTs generated with a magnetized coaxial plasma gun. CTs have been generated in prolate and oblate cylindrically symmetric metallic flux conservers. The plasma and magnetic field properties are studied through the use of magnetic probes, Thomson scattering, interferometry, and spectroscopy.

5580 **(ORNL/TM—7333) Charge exchange measurements of ion behavior in the ISX tokamak.** Neilson, G.H. Jr. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 272p. NTIS, PC A12/MF A01.

Analysis of charge exchange neutrals is the standard method for measuring ion behavior in tokamak plasmas. Limitations of this technique, which arise in dense and neutral-beam-heated plasmas, are discussed. Two refinements that address these limitations are described: a neutral particle analyzer, which incorporates both mass and energy resolution to distinguish different ion components such as the fast and thermal ions in beam-heated plasmas, and an improved data analysis procedure, which accounts for the effects of profiles and neutral attenuation in dense plasmas. A simple two-dimensional Monte Carlo neutral transport code was developed and used to investigate the effects of toroidally asymmetric neutral density profiles. Applications of these methods to experiments in the Impurity Study Experiment (ISX) are discussed; they include energy confinement studies on ISX-A, natural beam heating and high beta studies on ISX-B, and pellet fueling studies on ISX-B.

5581 **(PPPL—1702(Rev.)) Maxwell-Vlasov equations as a continuous Hamiltonian system.** Morrison, P.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1980. Contract AM02-76CH03073. 13p. NTIS, PC A02/MF A01.

The well-known Maxwell-Vlasov equations that describe a collisionless plasma are cast into Hamiltonian form. The dynamical variables are the physical although noncanonical variables E, B, and f. We present a Poisson bracket which acts on these variables and the energy functional to produce the equations of motion.

5582 **(PPPL—1720) Double layers without current.** Perkins, F.W.; Sun, Y.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1980. Contract AM02-76CH03073. 17p. NTIS, PC A02/MF A01.

The steady-state solution of the nonlinear Vlasov-Poisson equations is reduced to a nonlinear eigenvalue problem for the case of double-layer (potential drop) boundary conditions. Solutions with no relative electron-ion drifts are found. The kinetic stability is discussed. Suggestions for creating these states in experiments and computer simulations are offered.

5583 **(PPPL—1726) Comments on adiabatic modifications to plasma turbulence theory.** Krommes, J.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1980. Contract AM02-76CH03073. 9p. NTIS, PC A02/MF A01.

Catto earlier introduced an interesting and plausible modification of the usual resonance-broadening prescription for obtaining the nonlinear dielectric function. He argued reasonably that one should employ that prescription only for the nonadiabatic response, and that one should treat the adiabatic response essentially exactly. However, Misguich, in a recent Comment on Catto's work, found an apparent divergence in a form for the renormalized dielectric which he argued was equivalent to Catto's. Misguich was thus led to conclude that, at least for stationary turbulence, Catto's form was suspect, and that a more intricate renormalization might have to be used to obtain a sensible, convergent result. It is argued that this conclusion is incorrect, at least for the reasons Misguich gives.

5584 (PPPL—1727) Anomalous diffusion and ion heating in the presence of electrostatic hydrogen cyclotron instabilities. Okuda, H.; Cheng, C.Z.; Lee, W.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1980. Contract AM02-76CH03073. 14p. NTIS, PC A02/MF A01.

One- and two-dimensional simulations have been carried out to study electrostatic ion cyclotron instabilities for a hydrogen plasma in a strong magnetic field. It is found that strong ion heating and anomalous cross-field diffusion comparable to Bohm diffusion take place associated with the instability. Implications of the instability to the recent observations in fusion devices and space plasmas are discussed.

5585 (UCID—18792) REM meter for pulsed sources of neutrons. Thorngate, J.E.; Hunt, G.F.; Rueppel, D.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Aug 1980. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01.

A rem meter was constructed specifically for measuring neutrons produced by fusion experiments for which the source pulses last 10 ms or longer. The detector is a ^{6}Li glass scintillator, 25.4 mm in diameter and 3.2 mm thick, surrounded by 11.5 cm of polyethylene. This detector has a sensitivity of 8.5 x 10^{4} counts/mrem. The signals from this fast scintillator are shaped using a shorted delay line to produce pulses that are only 10 ns long so that dose equivalent rates up to 12 mrem/s can be measured with less than a 1% counting loss. The associated electronic circuits store detector counts only when the count rate exceeds a preset level. When the count rate returns to background, a conversion from counts to dose equivalent is made and the results are displayed. As a means of recording the number of source pulses that have occurred, a second display shows how many times the preset count rate has been exceeded. Accumulation of detector counts and readouts can also be controlled manually. The unit will display the integrated dose equivalent up to 200 mrem in 0.01 mrem steps. A pulse-height discriminator rejects gamma-ray interactions below 1 MeV, and the detector size limits the response above that energy. The instrument can be operated from an ac line or will run on rechargeable batteries for up to 12 hours.

5586 (UCRL—85122) Formation of compact toroidal plasmas by magnetized coaxial plasma gun injection into an oblate flux conserver. Turner, W.C.; Goldenbaum, G.C.; Granneman, E.H.A.; Hartman, C.W.; Prono, D.S.; Taska, J.; Smith, A.C. Jr. (California Univ., Livermore (USA). Lawrence Livermore National Lab.; Pacific Gas and Electric Co., San Francisco, CA (USA)). 4 Nov 1980. Contract W-7405-ENG-48. 13p. (CONF-801215—5). NTIS, PC A02/MF A01.

From 3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program; Los Alamos, NM, USA (2 Dec 1980).

Initial results are reported on the formation of compact toroidal plasmas in an oblate shaped metallic flux conserver. A schematic of the experimental apparatus is shown. The plasma injector is a coaxial plasma gun with solenoid coils wound on the inner and outer electrodes. The electrode length is 100 cm, the diameter of the inner (outer) electrode is 19.3 cm (32.4 cm). Deuterium gas is puffed into the region between electrodes by eight pulsed valves located on the outer electrode 50 cm from the end of the gun. The gun injects into a cylindrically symmetrical copper shell (wall thickness = 1.6 mm) which acts as a flux conserver for the time scale of experiments reported here. The copper shell consists of a transition cylinder 30 cm long, 34 cm in diameter, a cylindrical oblate pill box 40 cm long, 75 cm in diameter and a downstream cylinder 30 cm long, 30 cm in diameter. The gap between the gun and transition cylinder is 6 cm. An axial array of coils outside the vacuum chamber can be used to establish an initial uniform bias field.

5587 (UCRL-Trans—11633) Absorption of laser radiation in a plasma with subcritical density. Aleksandrov, V.V.; Vikharev, V.D.; Koval'skii, P.G.; Pergament, M.I.; Rubenchik, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Nov 1980. Translation of IAE-3196. 18p. NTIS, PC A02/MF A01.

Results are given of experimental research on the absorption of laser radiation by a plasma under conditions where all absorption mechanisms due to processes occurring in the region with a density ~ n/sub cr/ are excluded. Special attention is paid to absorption in the zone n ~ n/sub cr//4; this absorption is associated with the development of the two-plasmon decay instability.

7002 Fusion Power Plant Technology

REFER ALSO TO CITATION(S) 5175, 5176

5588 (BNL—28480) Design studies of an aluminum first wall for INTOR. Powell, J.R.; Fillo, J.A.; Yu, W.S.; Hsieh, S.Y.; Pearlman, H.; Kramer, R.; Franz, E.; Craig, A.; Farrell, K. (Brookhaven National Lab., Upton, NY (USA); Rockwell International Corp., Canoga Park, CA (USA); Aluminum Co. of America, Alcoa Center, PA. Alcoa Labs.; Oak Ridge National Lab., TN (USA)). 1980. Contract AC02-76CH00016. 8p. (CONF-800950—15). NTIS, PC A02/MF A01.

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

Examination of the plasma performance expected for INTOR indicates that there will probably be high fluxes of charge exchange neutrals to the first wall. The average energies of these neutrals is sufficiently large, in the range of ~ 100 to 300 eV, so that substantial erosion of the first wall by sputtering appears likely. A second concern is the effect of plasma disruptions on the integrity of the INTOR first wall. Every so often in existing Tokamak experimental facilities the plasma suddenly becomes unstable and rapidly dumps its stored energy (thermal and magnetic) onto a portion of the plasma chamber. In addition to the potentialy high-erosion rates (including evaporation) expected for INTOR, but depending on the plasma scenario, there may also be substantial heat flux to the first wall, e.g., ~ 9 (Case I) to 24 (Case II) W/cm^{2}. This will come from two sources - radiation and charge exchange neutrals. There will also be internal heat generation by neutron and gamma deposition that must be taken into account since we are considering first wall structures of ~ 3 cm thickness. It is with respect to the above concerns (erosion, evaporation, and high-heat flux) that the aluminum design is addressed.

5589 (CONF-801011—79) Development of remote welding equipment and techniques for the TFTR vacuum vessel. Masson, L.S.; Watts, K.D.; Larson, R.A.; Aldrich, W.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 6p. NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

In the event that the TFTR vacuum vessel is damaged or one of the toroidal field coils fails after the system has become substantially activated, it is necessary to remotely remove and replace the damaged section of the vessel using remote handling procedures. This paper describes a welding system developed through the final design stage to perform the remote welding necessary during the replacement operation. Information is presented describing the vessel configuration, the replacement sequence, the welding system requirements, welder configuration, supporting systems, the weld development program and future development requirements.

5590 (CONF-801111—24) Demonstration of direct energy recovery of full energy ions at 40 keV on a PLT/ISX beam system. Stirling, W.L.; Barber, G.C.; Dagenhart, W.K. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 19p. NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

The desire for multisecond beams in the 80-keV/nucleon energy range at 10 MW/module has emphasized the need for technological advances in several areas. At such beam energies, as much as 75% of the initial beam energy is retained in the unneutralized ion components. As a result, two questions immediately come to mind: how can one dispose of this energy; or better still, how can one efficiently recover this energy. The conventional way of treating such a problem is to deflect the ions out of the neutral beam and onto water-cooled plates or beam dumps. This method

has worked satisfactorily for 40-keV/nucleon beams in excess of 1.5 MW and ~ 0.5 s. However, the power per unit area to be disposed of in the high power, multisecond beams mentioned above is beyond present-day technology. We have proposed and demonstrated a unique solution to this problem which not only removes the need for beam dumps but also returns from 50 to 80% of the energy contained in the full energy ion component directly and dynamically to the high voltage supply. In fact, the energy in the residual ion component is not expended. The tests were made on a PLT/ISX type beam line at 40 keV/nucleon of about 800 kW and 0.1 s.

5591 **(DOE/ER—0088) Status of compact-toroid research using high energy particle beams.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Oct 1980. 21p. NTIS, PC A02/MF A01.

A workshop on the use of high-energy particle beams to generate compact-toroid plasma geometries was held at the Department of Energy (Germantown) on June 26-27, 1980, for the purpose of assisting the Division of Applied Plasma Physics in formulating program plans for this work, and assessing its importance relative to the rest of the compact toroid (CT) program. The scope of the workshop is given in Appendix A, and the charge to the panel of advisors responsible for writing this report is given in Appendix B.

5592 **(DOE/ET/52025—3) Fusion studies program. Annual report, November 1, 1979-October 31, 1980.** Stacey, W.M. Jr. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). 1980. Contract AS05-78ET52025. 58p. NTIS, PC A04/MF A01.

The following two papers are included: (1) effect of a localized magnetic perturbation on magnetic islands in a cylindrical plasma, and (2) a divertor magnetic field line following code. (MOW)

5593 **(DOE/TIC—11340) Tensile properties and microstructure of helium injected and reactor irradiated V-20 Ti.** Tanaka, M.P.; Bloom, E.E.; Horak, J.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01.

The objective of this work was to determine the effect of preinjected helium followed by neutron irradiation on the mechanical properties and microstructure of V-20% Ti. These results will be used for the evaluation of the potential use of V-20% Ti in fusion reactor service.

5594 **(DOE/TIC—11359) Software enhancement to produce report-quality graphics from GIFTS.** Gray, W.H.; Baudry, T.V. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01.

The Oak Ridge National Laboratory (ORNL) maintains two versions of the GIFTS system structural analysis computer program modules, one for two DECsystem-10's located at Oak Ridge, Tennessee, the other for a Cray-1 located at Livermore, California. These computers are connected via high-band-width terrestial communications equipment. Presented herein are the local software enhancements for the ORNL version of GIFTS that permit creation of intermediate graphics files. These files may be postprocessed to produce report-quality display images on a variety of graphics devices at ORNL.

5595 **(HEDL—6882) Nuclear data for damage studies and FMIT (WHO25/EDK). Quarterly report, July-September 1980.** Johnson, D.L.; Mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1980. Contract AC14-76FF02170. 10p. NTIS, PC A02/MF A01.

Neutron and gamma ray spectra data have been obtained from analysis of measurements of the transmission of FMIT-like neutrons through thick iron. These data will be used to confirm neutron transport calculations used for predictions of radiation heating in FMIT test cell walls but will also shed light on neutron transport calculations within an experimental test matrix.

5596 **(HEDL-SA—2197) Selection of materials for ETF.** Nygren, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 14 Oct 1980. Contract AC14-76FF02170. 13p. (CONF-801011—75). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

Repeated operation of a long burning, ignited plasma in ETF implies high exposure to an intense source of energetic particles and high energy (14.1 MeV) neutrons and presents a unique environment for materials in ETF compared with earlier tokamaks. Designing ETF (and FED) will provide many insights into reactor relevant design issues related to materials performance, particularly in components outside the first wall. This paper focuses primarily on how exposure to the plasma and radiation damage to materials infuence the design lifetime of particular components, including the first wall, armor, and TF coils. Also discussed are radiaton exposure limits for repair welding of the torus and for electrical materials used in RF and diagnostics.

5597 **(LA-UR—80-2822) Accelerator development for heavy ion fusion.** Talbert, W.L. Jr.; Sawyer, G.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 14p. (CONF-801111—6). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

Accelerator technology development is presented for heavy ion drivers used in inertial confinement fusion. The program includes construction of low-velocity "test bed" accelerator facilities, development of analytical and experimental techniques to characterize ion beam behavior, and the study of ion beam energy deposition.

5598 **(LA-UR—80-3186) Trends in instrumentation for environmental radiation measurements at Los Alamos Scientific Laboratory.** Hiebert, R.D.; Wolf, M.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-801103—21). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

Portions of document are illegible.

Recent instruments developed to fulfill radiation monitoring needs at Los Alamos Scientific Laboratory are described. Laboratory instruments that measure tritium gas effluents alone, or in the presence of activated air from D-T fusion reactors are discussed. Fully portable systems for gamma, x-ray, and alpha analyses in the field are described. Also included are descriptions of survey instruments that measure low levels of transuranic contaminants and that measure pulsed-neutron dose rates.

5599 **(LA-UR—80-3214) Initial ionization stage of FRC formation.** Commisso, R.J.; Armstrong, W.T.; Cochrane, J.C.; Ekdahl, C.A.; Lipson, J.; Linford, R.K.; Sherwood, E.G.; Siemon, R.E.; Tuszewski, M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801215—8). NTIS, PC A02/MF A01.

From 3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program; Los Alamos, NM, USA (2 Dec 1980).

A Field-Reversed Configuration (FRC) is a prolate compact torus that is confined by poloidal fields only. Theta-pinch formation of an FRC employs an initial bias field, B_{t_i}, whose direction is opposite to that of the main theta-pinch field. Some fraction of the flux associated with this bias field eventually constitutes the closed-field-line flux of the FRC. Experimental and theoretical evidence suggest that the longest-lived FRC's are obtained when the closed flux is maximized. Because the initial ionization is done in the presence of the bias field, the actual bias flux available at the time of application of the main theta-pinch field depends strongly on the initial ionization, or preionization, technique used. In this paper we report on experiments characterizing the previously used theta-pinch preionization technique that employed a net field (bias plus preionization) null, or zero-crossing, of the axial component of the magnetic field to break down the gas. We also discuss results of experiments designed to develop preionization techniques in which the gas breakdown is not accomplished by a zero-crossing.

5600 (LA-UR—80-3227) FRC studies on FRX-B. Armstrong, W.T.; Cochrane, J.C.; Lipson, J.; Linford, R.K.; McKenna, K.F.; Sgro, A.G.; Sherwood, E.G.; Siemon, R.E.; Tuszewski, M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801215—7). NTIS, PC A02/MF A01.

From 3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program; Los Alamos, NM, USA (2 Dec 1980).

Recent experimental studies of Field-Reversed Configurations (FRC) on the FRX-B device have included (1) characterization of FRC formation with regard to loss of bias flux, (2) examination of FRC equilibria through separatrix profiles, (3) formation of FRC's with different end-mirror configurations, and (4) extension of FRC parameter range. Studies on loss of bias flux during the pre-ionization (PI) phase of FRC formation are presented in another paper dedicated solely to PI considerations. Loss of bias flux during the reversal phase of FRC formation is reviewed in the first section of this paper. Use of barrier fields during the reversal phase to enhance trapping of bias flux is included in the third section of this paper. In addition to barrier field studies, results from different mirror configurations are also discussed in the third section. A critical diagnostic for interpretation of the results from the different machine modifications is the excluded-flux probe array. Analysis of excluded-flux measurements to obtain the FRC separatrix profile is described in the second section. Finally, preliminary results of FRX-B operation in an extended range of plasma parameters is briefly discussed in the fourth section.

5601 (LA-UR—80-3261) Formation and evolution of the PS-1 spheromak. Sgro, A.G.; Lui, H.C.; Chu, C.K.; Winske, D. (Los Alamos Scientific Lab., NM (USA); Columbia Univ., New York (USA); Maryland Univ., Baltimore (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801215—2). NTIS, PC A02/MF A01.

From 3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program; Los Alamos, NM, USA (2 Dec 1980).

A numerical analysis of spheromak formation and evolution gives insight into the physical processes involved and the equilibrium configuration achieved. By varying the initial and boundary conditions, methods for achieving stable equilibria may be predicted. In this report, preliminary results of a numerical analysis of the PS-1 spheromak are presented.

5602 (LA-UR—80-3262) Flux loss during the formation of FRC. Sgro, A.G. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-801215—3). NTIS, PC A02/MF A01.

From 3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program; Los Alamos, NM, USA (2 Dec 1980).

One important feature of FRC formation is the loss of the reversed flux. In this note we present the results of simulations that are intended to study this loss.

5603 (LA-UR—80-3263) Reconnection during the implosion phase of field reversed configurations. Hewett, D.W.; Seyler, C.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801215—4). NTIS, PC A02/MF A01.

From 3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program; Los Alamos, NM, USA (2 Dec 1980).

Magnetic field topology changes in Field Reversed Configurations (FRC's) are essential for the formation and containment of the plasma. A significant part of the FRC research program relies upon the idea that a newly formed plasma, formed on open field lines will quickly change field topology before the rapid parallel electron thermal conduction depletes the plasma energy. We have simulated the implosion dynamics of FRC formation using an axisymmetric hybrid model consisting of kinetic ions and finite resistivity fluid electrons. The LASL FRC experiments are well described by our model, which assumes quasineutrality, zero electron inertia, and no electromagnetic radiation.

5604 (LA-UR—80-3297) High-current four-beam xenon ion source for heavy-ion fusion. Shubaly, M.R.; Hamm, R.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-801111—29). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

The growing interest in inertial confinement fusion using heavy ions has elicited from the Los Alamos Scientific Laboratory a proposal to use a multi-channel radio-frequency quadrupole (RFQ) structure for the initial stage of the heavy-ion accelerator. The RFQ would have 4 channels in each module and each channel would accelerate 25 mA of Xe^{+1}. Based on experiments with xenon beam production with a high current duoPIGatron source at Chalk River Nuclear Laboratories, a 245 keV 4-beam xenon injector has been designed for this 4-channel RFQ. The injector is of modular design with 4 small independent plasma sources mounted in a 10 cm square array on a common combined extraction and acceleration column. The electrodes have 4 separate sets of apertures and each channel produces a 29 mA beam for injection into its corresponding RFQ channel. This paper presents a conceptual design for the injector, code calculations for the column electrode design and results of a preliminary test carried out to verify the feasibility of the concept.

5605 (LA-UR—80-3307) Perturbation analysis of rail guns powered by explosive magnetic flux compression. Peterson, D.R.; Fowler, C.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 18p. (CONF-801138—6). NTIS, PC A02/MF A01.

From Electromagnetic guns and launchers conference; San Diego, CA, USA (4 Nov 1980).

Perturbation methods are used to predict the performance of rail guns powered by explosive magnetic flux compression, and the results are compared with experimental data. The problem of designing explosive magnetic flux compression generators for optimum rail gun performance is also discussed.

5606 (LBL—11809) Heavy ion fusion half-year report, April 1-September 30, 1980. Staff, H.I.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01.

Major accomplisments in the second half of Fiscal Year 1980 include: the large aperture Cs^{+1} contact ionization source has been operational through most of this period. The full system comprised of source plus three drift tubes was brought into operation early in April 1980. Beam profiles and current measurements indicate that the system performs close to design specifications. System studies have been expanded to include multiple beam systems, in addition to the single beam systems studied heretofore. Work has continued on the development of beam diagnostic devices. Most of the effort has been directed toward the development of the electron beam probe and scintillator systems. Zeolite source development is continuing, with major emphasis on source stability and lifetime. A model for the longitudinal resistive wall instability has been developed which indicates the induction linac beam should be stable to first order in the resistance. Considerable theory effort has also been concentrated upon the transport of space charge dominated beams through periodic focussing structures. A multiple electrostatic quadrupole array capable of handling forty nine parallel beamlets has been designed and constructed.

5607 (NRL-MR—4387) NRL light ion beam research for inertial confinement fusion. Cooperstein, G.; Goldstein, S.A.; Mosher, D. (Naval Research Lab., Washington, DC (USA)). 20 Nov 1980. Contract AI01-77DP40042. 40p. NTIS, PC A03/MF A01.

There is presently great interest in using light ion beams to drive thermonuclear pellets. Terrawatt-level ion beams have been efficiently produced using conventional pulsed power generators at Sandia Laboratory with magnetically-insulated ion diodes and at the Naval Research Laboratory with pinch-reflex ion diodes. Both laboratories have recently focused ion beams to pellet dimensions. This paper reviews recent advances made at NRL in the area of ion production with pinch-reflex diodes, and in the areas of beam focusing and transport. In addition, modular generator and beam

requirements for pellet ignition systems are reviewed and compared with the latest experimental results. These results include the following: (1) production of >100 kJ proton and deuteron beams with peak ion powers approaching 2 TW on the PITHON generator in collaboration with Physics International Co., (2) focusing of 0.5 TW deuteron beams produced on the NRL Gamble II generator to current densities of about 300 kA/cm^2, and (3) efficient transport of 100 kA level ion beams over 1 meter distances using Z-discharge plasma channels.

5608 **(PB—80-170384) Estimated target accuracies for neutronic responses in fusion reactors.** Verschuur, K.A. (Netherlands Energy Research Foundation, Petten). Dec 1979. 19p. NTIS, PC A02/MF A01.

Neutronics responses play an important role in plant design, in that way that they determine dimensions of components, the lifetime of components, the thermal power produced, and ultimately the electricity cost. Most system studies contain sufficient information to derive cost sensitivities for the main neutronic responses, which then can be used for the estimation of target accuracies. Target accuracies for the energy-multiplication of the blanket, the tritium breeding ratio, the radiation damage and radiation heating of the superconducting coils and the dose rate behind the biological shield, have been calculated for three UWMAK studies, the PPPL, and the reversed field pinch of Culham and Los Alamos.

5609 **(PNL-SA—8527) Evaluation of fusion-fission energy systems.** Willingham, C.E.; Bickford, W.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1980. Contract AC06-76RL01830. 8p. (CONF-801011—73). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

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The Office of Fuel Cycle Evaluation of the Department of Energy has conducted a Nonproliferation Alternative Systems Assessment Program (NASAP). The goal of the NASAP is to provide recommendations in the development of nuclear energy systems which have potential for reducing the risk of nuclear weapons proliferation while satisfying the short- and long-term needs for nuclear energy. The fusion-fission hybrid is one of the nuclear energy systems which have been considered for long-term applications. This paper presents the information needed to evaluate and analyze hybrids for the NASAP. Although most of the combined driver-blanket hybrid systems considered in this study have not been optimized for performance and cost, the resulting data provides valuable insights into the future potential hybrids.

5610 **(PPPL—1723) Quasistatic formation of the spheromak plasma configuration.** Yamada, M.; Furth, H.P.; Hsu, W.; Jardin, S.; Janos, A.; Okabayashi, M.; Sinnis, J.; Stix, T.H.; Yamazaki, K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1980. Contract AM02-76CH03073. 16p. NTIS, PC A02/MF A01.

A novel method for creating the spheromak configuration has been proposed and verified experimentally. The scheme is based on a transfer of poloidal and toroidal magnetic fluxes into a plasma from a flux core. In this paper we present the first experimental verification of this quasistatic (tau/sub Alf/ much less than tau/sub form/ < tau/sub diff/) formation scheme, which is suitable for future scale-up to fusion-reactor parameters.

5611 **(SAND—80-1493C) High output neutron tube using an occluded gas ion source.** Walko, R.J.; Rochau, G.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 16p. (CONF-801111—31). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

A neutron tube capable of generating 10^{10} 14 MeV neutrons in a 1.2 ms pulse has been developed for the Nuclear Regulatory Commission for use in flow measurements using the Pulsed Neutron Activation technique. The tube consists of an occluded deuterium gas ion source, a single gap accelerator and a scandium tritide target. A unique feature of the tube design is its complete demountability, permitting easy replacement or modification of critical components. The ion source is a modified version of a stacked occluded washer source. However, in contrast to previous designs, this source utilizes only a single scandium deuteride washer and needs no independent trigger. Outputs of 1.2 x 10^{10} neutrons per pulse from a 250 mA deuterium ion beam at 125 kV have been obtained for over 1500 consecutive operations with a standard deviation of only +- 5%. The ultimate operational lifetime is believed to be in excess of 3000 shots based on the present knowledge of ion source behavior. Recent experiments using nonmagnetic structural components in the ion source resulted in a 26% increase in output with a simultaneous 35% reduction in the source drive current. This implies that even higher outputs with greater source efficiencies may be achievable.

5612 **(UCRL—15300) Analysis of Boling's laser-damage morphology.** Sparks, M.S. (M. S. Consultants, Inc., Santa Monica, CA (USA)). 15 Aug 1980. Contract W-7405-ENG-48. 57p. NTIS, PC A04/MF A01.

Boling observed that his total-internal-reflection laser-damage sites in glass closely resembled the scattering cross section for small (ka << 1), perfectly conducting sphere and suggested that a very small plasma formed and grew to a larger size, still with ka << 1 satisfied. Even with ka = 1, for which the cross section is different from that observed, the scattered field still is too small to explain the damage in terms of constructive interference between the incident- and scattered fields. Furthermore, the characteristic shape of the scattering cross section that matches the damage patterns is for circular polarization or unpolarized light, in contrast to the experimental plane polarizations. Extending the ideas to include effects of the scattered field outside the glass, such as plasma formation, and to include the correct field (with interesting polarization, including longitudinal circuler polarization at certain distances from the surface) incident on the sphere may explain the experiments. Additional experiments and analysis would be useful to determine if the extended model is valid and to investigate related materials improvement, nondestructive testing, and the relation between laser damage, plasma initiation, and failure under stress, all initiated at small isolated spots.

5613 **(UCRL—83998) uv preilluminated gas switches.** Bradley, L.P.; Orham, E.L.; Stowers, I.F.; Braucht, J.R. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 3 Jun 1980. Contract W-7405-ENG-48. 16p. (CONF-800640—19). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

We have designed, built, and characterized uv preilluminated gas switches for a trigger circuit and a low inductance discharge circuit. These switches have been incorporated into a 54 x 76 x 150 cm pulser module to produce a 1 Ma output current rising at 5 x 10^{12} amps/sec with 1 ns jitter. Twenty such modules will be used on the Nova Inertial Confinement Fusion Laser System for plasma retropulse shutters.

5614 **(UCRL—84624) Tandem mirror next step: remote maintenance.** Doggett, J.N.; Damm, C.C.; Hanson, C.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Oct 1980. Contract W-7405-ENG-48. 30p. (CONF-801107—41). NTIS, PC A03/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

This study of the next proposed experiment in the Mirror Fusion Program, the Tandem Mirror Next Step (TMNS), has included serious consideration of the maintenance requirements of such a large source of high energy neutrons with its attendant throughput of tritium. Although maintenance will be costly in time and money, our conclusion is that with careful attention to a design for maintenance plan such a device can be reliably operated.

5615 **(UCRL—84787) Design of laser-generated shock-wave experiments. An approach using analytic models.** Lee, Y.T.; Trainor, R.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 7 Nov 1980. Contract W-7405-ENG-48. 33p. (CONF-801119—2). NTIS, PC A03/MF A01.

From 22. annual meeting of the division of plasma physics of the APS; San Diego, CA, USA (10 Nov 1980).

Two of the target-physics phenomena which must be understood before a clean experiment can be confidently performed are preheating due to suprathermal electrons and shock decay due to a shock-rarefaction interaction. Simple analytic models are described for these two processes and the predictions of these models are compared with those of the LASNEX fluid physics code. We have approached this work not with the view of surpassing or even approaching the reliability of the code calculations, but rather with the aim of providing simple models which may be used for quick parameter-sensitivity evaluations, while providing physical insight into the problems.

5616 **(UWFDM—375) Commercial tandem mirror reactor design with thermal barriers: WITAMIR-I.** Kulcinski, G.L.; Emmert, G.A.; Maynard, C.W. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Oct 1980. Contract AS02-78ET52048. 16p. (CONF-801011—68). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

A conceptual design of a near term commercial tandem mirror power reactor is presented. The basic configuration utilizes yin-yang minimum-B plugs with inboard thermal barriers. The maximum magnetic fields are 6.1 T, 8.1 T, and 15 T in the central cell, yin-yang, and thermal barrier magnets, respectively. The blanket utilizes $Pb_{83}Li_{17}$ as the coolant and HT-9 as the structural material. This yields a high energy multiplication (1.37), a sufficient tritium breeding ratio (1.07) and has a major advantage with respect to maintenance. The plasma Q is 28 at a fusion power level of 3000 MW(t); the net electrical output is 1530 MW(e); and the overall efficiency is 39%. Cost estimates indicate that WITAMIR-I is competitive with recent tokamak power reactor designs.

5617 **(UWFDM—380) WITAMIR-I: a tandem mirror reactor with non-zero Nu.** Santarius, J.; Audenaerde, K.; Beyer, J. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Sep 1980. Contract AS02-78ET52048. 7p. (CONF-800950—16). NTIS, PC A02/MF A01.

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

WITAMIR-I, a teandem mirror reactor, is a study by the University of Wisconsin fusion engineering design group. Various engineering aspects and physics considerations are presented. WITAMIR-I is a high Q device with particularly attractive maintenance features and blanket characteristics.

5618 **(WFPS-TME—80-014) Westinghouse ICF power plant study.** Sucov, E.W. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Oct 1980. Contract AC08-79DP40086. 10p. (CONF-801011—77). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

In this study, two different electric power plants for the production of about 1000 MWe which were based on a CO_2 laser driver and on a heavy ion driver have been developed and analyzed. The purposes of this study were: (1) to examine in a self consistent way the technological and institutional problems that need to be confronted and solved in order to produce commercially competitive electricity in the 2020 time frame from an inertial fusion reactor, and (2) to compare, on a common basis, the consequences of using two different drivers to initiate the DT fuel pellet explosions. Analytic descriptions of size/performance/cost relationships for each of the subsystems comprising the power plant have been combined into an overall computer code which models the entire plant. This overall model has been used to conduct trade studies which examine the consequences of varying critical design values around the reference point.

5619 **Next step in fusion: what it is and how it is being taken.** Clarke, J.F. (Dept. of Energy, Washington, DC). *USScience (U.S.);* **210**: No. 4473, 967-972(28 Nov 1980).

Fusion and its relation to the long-term energy supply are discussed. The DOE developmental policy for fusion is outlined. A brief review of the tokamak Experimental Test Facility program is given. (MOW)

5620 **Overlap of intense charged particle beams for inertial confinement fusion.** Halbleib, J.A.; Miller, P.A.; Mix, L.P.; Wright, T.P. (Sandia National Labs., Albuquerque, NM). *GBNature (London) (England);* **286**: 366-368(24 Jul 1980).

To close the gap between present capabilities and future requirements, beam bunching and beam overlap are being studied. The current density gain G is important to the CPB overlap process and is the ratio of beam current density at the target surface to that of the individual beams in the transport channels; it depends on particle species, transverse energy, geometry of the channel-target interface, and so on. Detailed calculations indicate that for electron beams, $G < 3$, while for practical cases of light ions, G can exceed 10. This is due to the difference in masses and effective temperatures of the two types of beams. Sources providing multiple ion beams are not available to test this overlap theory experimentally; hence it has been tested using a multiple electron beam system. Here we outline the experiment and describe the apparatus, and then summarize the theoretical treatment of beam overlap, describe diagnostic procedures, and compare the experimental results with calculations.

5621 **Materials for thermonuclear fusion reactors** Gruen, D.M. (Argonne National Lab., IL). *PLMaterials Science (Poland);* 325-379(1979).

The following topics are considered: (1) effects of radiation on CTR materials, (2) first wall materials and divertor trapping surfaces, (3) blanket materials, (4) superconducting materials, and (5) tritium permeation barriers. (MOW)

99 GENERAL AND MISCELLANEOUS

9901 Management

5622 **(CONF-801113—5) Managing people problems in changing to computerized text processing.** Walker, T.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01.

From 4. annual practical conference on communications; Gatlinburg, TN, USA (7 Nov 1980).

Change is always both a promise and a threat. Changing to a computerized text processing system is, from a management viewpoint, mostly a promise; but, from an employee viewpoint, mostly a threat. A variety of people problems arise from such a changeover because of the perceived threats involved. Most of these problems can be expected, so that, by proper management, their effects can be reduced or eliminated.

5623 **(DOE/AD—0010/12) Selected DOE Headquarters publications, October 1979-.** (Department of Energy, Washington, DC (USA). Energy Library). Nov 1980. 86p. NTIS, PC A05/MF A01.

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This publication provides a cumulative listing of and an index to DOE headquarters publications issued since October 1979. (Publications issued during October 1977 to September 1979 are covered in DOE/AD-0010/6.) Three types of headquarters publications are included: publications dealing mainly with program and policy that are attributed to and issued by headquarters organizations, reports prepared by contractors (and published by DOE) to describe research and development work they have performed for the Department, and environmental development plans, environmental impact statements, and environmental readiness documents. Certain publications have been omitted. They include such items as pamphlets, fact sheets, bulletins, newsletters, and telephone directories. Also omitted are weekly/monthly reports of the Energy Information Administration and headquarters publications issued under the DOE-tr and CONF codes. (RWR)

5624 **(UCID—18847(Pt.1)) Project Management Code. Part 1: functional requirements.** Ames, H.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Nov 1980. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01.

The functional requirements for an information management system called Project Management Code (PMC) are described.

PMC is a simple computerized tool which managers can use to plan, evaluate, and report the technical and financial progress of a project through use of the work breakdown structure (WBS) as the graphical means of representing input and output. PMC provides an automated means to develop and maintain interactively the WBS for a project. In addition, there are tabular reports for summarizing data. 9 figures.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 5314, 5562, 5594

5625 **(ANL—80-116) LCLSQ: an implementation of an algorithm for linearly constrained linear least-squares problems.** Crane, R.L.; Garbow, B.S.; Hillstrom, K.E.; Minkoff, M. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 45p. NTIS, PC A03/MF A01.

This report describes the implementation of an algorithm of Stoer and Schittkowski for solving linearly constrained linear least-squares problems. These problems arise in many areas, particularly in data fitting where a model is provided and parameters in the model are selected to be a best least-squares fit to known experimental observations. By adding constraints to the least-squares fit, one can force user-specified properties on the parameters selected. The algorithm used applies a numerically stable implementation of the Gram-Schmidt orthogonalization procedure to deal with a factorization approach for solving the constrained least-squares problem. The software developed allows for either a user-supplied feasible starting point or the automatic generation of a feasible starting point, redecomposition after solving the problem to improve numerical accuracy, and diagnostic printout to follow the computations in the algorithm. In addition to a description of the actual method used to solve the problem, a description of the software structure and the user interfaces is provided, along with a numerical example. 3 figures, 1 table.

5626 **(DOE/ER/03077—168) Progress report No. 56, October 1, 1979-September 30, 1980.** (New York Univ., NY (USA). Courant Mathematics and Computing Lab.). 1 Oct 1980. Contract AC02-76ER03077. 38p. NTIS, PC A03/MF A01.

Research during the period is sketched in a series of abstract-length summaries. The forte of the Laboratory lies in the development and analysis of mathematical models and efficient computing methods for the rapid solution of technological problems of interest to DOE, in particular, the detailed calculation on large computers of complicated fluid flows in which reactions and heat conduction may be taking place. The research program of the Laboratory encompasses two broad categories: analytical and numerical methods, which include applied analysis, computational mathematics, and numerical methods for partial differential equations, and advanced computer concepts, which include software engineering, distributed systems, and high-performance systems. Lists of seminars and publications are included. (RWR)

5627 **(LBL—11018) Time Projection Chamber digitizer test system using a microcomputer.** Nunnally, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 6p. (CONF-801103—19). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

A small computer system for testing digitizers, control cards, and backplanes was developed at the Lawrence Berkeley Lab to be used in the Time Projection Chamber (TPC) Detector. The objective of this development was to provide a low cost test system for fast debugging, maintenance, a quality control by outside vendors who fabricated these units as well as Laboratory personnel. When the system was delivered to the vendors, it consisted of the computer programming and documentation necessary to do a complete checkout of approximately 20,000 signal channels. To obtain this low cost system (totaling $1400) a commercial microcomputer with 16K of memory and a printer (40 characters per line, 30 characters per second) were selected. This paper describes the overall test system and programming features including the linking capabilities of the debug program. It also describes the various interfacing techniques that were used to obtain hardcopies.

5628 **(ORNL/CSD—68) Advantages of inverted operators in Rayleigh-Ritz approximations.** Scott, D.S. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01.

Generalized eigenvalue problems are often solved by a combination of inverse iteration and the Rayleigh-Ritz procedure. It is shown that significant advantages can be obtained in this context by applying the Rayleigh-Ritz procedure to an inverted operator.

5629 **(ORNL/CSD—70) Solution of homogeneous systems of linear equations arising from compartmental models.** Funderlic, R.E.; Mankin, J.B. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01.

Systems of linear differential equations with constant coefficients, Ax = x-dot, with the matrix A having nonnegative off-diagonal elements and zero column sums occur in compartmental analysis. The steady-state solution leads to the homogeneous system of linear equations Ax(∞) = x-dot(∞) = 0. LU factorization, the Crout algorithm, error analysis, and solution of a modified system are treated. 3 figures.

5630 **(ORNL/TM—7353) User and system considerations for the TCSTEK software library: a graphics library for displaying images on Tektronix 4000 series storage tube terminals.** Gray, W.H. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 47p. NTIS, PC A03/MF A01.

This report documents the idiosyncrasies of the Tektronix PLOT 10 Terminal Control System (TCS) level 3.3 software as it currently exists on the Oak Ridge National Laboratory Fusion Energy Division DECsystem-10 computer. It pertains to the graphics software library called TCSTEK, which may be used to convert TCS subroutine calls into display images on the screens of Tektronix 4000 series storage tube terminals. Fully described here are several user-oriented enhancements and system efficiency modifications to the vendor-supplied TCS software library. It is intended that this report serve as a reference for future TCS updates so that continuity between releases of TCS PLOT 10 software may be maintained. 1 figure.

5631 **(SAND—80-2181) AJAX User's Guide.** Fimple, M.D. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01.

AJAX is a computer program which processes programs written in DIGITAL FORTRAN-IV PLUS language, and produces new versions of these programs. The most important feature of a program produced by AJAX is that the numbered statements in the program will be renumbered such that they will be monotonically increasing from start to finish. Other formatting features are available as options. AJAX is written in VAX FORTRAN-IV PLUS language and runs on version 1.6 of the VMS operating system.

5632 **(SLAC-PUB—2633) VAX CAMAC channel.** Nelson, D.J.; Breidenbach, M.; Granieri, C.D.; Grund, J.E.; Patrick, J.F.; Weaver, L.J. (Stanford Linear Accelerator Center, CA (USA)). Oct 1980. Contract AC03-76SF00515. 5p. (CONF-801103—34). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

A new generation CAMAC System has been developed for the Mark II Detector at SLAC's PEP storage ring. This flexible system can efficiently transfer data between a host computer and a very large set of CAMAC data acquisition and control modules. A bipolar microprocessor operates as a Channel interface by supervising the CAMAC system and minimizing the host computer's work. This programmable channel couples the host to a set of System Crates; each System Crate houses Branch Drivers that can directly control a set of crates or communicate over differential parallel highways to Branch Receivers for control of distant crates. A coherent software package integrates the high level programs, system driver level programs, and microcode control of the system.

5633 (SLAC-PUB—2640) Front panel human interface for FASTBUS. Gustavson, D.B.; Holmes, T.L.; Paffrath, L.; Steffani, J.P. (Stanford Linear Accelerator Center, CA (USA)). 1980. Contract AC03-76SF00515. 3p. (CONF-801103—26). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

A human interface based on the Snoop<1> diagnostic module has been designed to facilitate checkout of FASTBUS<2> devices, diagnosis of system faults, and monitoring of system performance. This system, which is a generalization of the usual computer front panel or control console, includes logic analyzer functions, display and manual-control access to other modules, a microprocessor which allows the user to create and execute diagnostic programs and store them on a minifloppy disk, and a diagnostic network which allows remote console operation and coordination of information from multiple segments' Snoops.

5634 (SLAC-TN—80-5) IBM channel to PDP11 interface. Oxoby, G.J. (Stanford Linear Accelerator Center, CA (USA)). Nov 1980. Contract AC03-76SF00515. 11p. NTIS, PC A02/MF A01.

An interface between a UNIBUS and a I/O Channel of the IBM 360/370 computer triplex at SLAC has been designed. IBM calls such a device a Control Unit, and it looks like a tape or a disk drive to the IBM computer. This means that any ordinary batch jobs can transfer data to or from a device connected to a UNIBUS. The programer gets access to the system by a FORTRAN-callable subroutine. This control unit permits bidirectional data transfers at up to 1 MB/s between an IBM 2860 Selector Channel and any DEC PDP11 minicomputer peripheral conforming to IBM GA22-6974 and DEC PDP11 UNIBUS interfacing specifications. The simulator developed to de bug this control unit without using one of the IBM computers is also described. (RWR)

5635 (UCID—18825) New formulation of backward differenced linear multistep methods for ordinary differential equations. Winslow, A.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Oct 1980. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01.

The ordinary differential equation dy/dt = f(y,t) is to be integrated numerically by a k/sup th/-order linear multistep method. Backward differencing is chosen for application to stiff equations. The novel feature of the formulation is the manner in which the history array is stored. The method has been applied to the numerical solution of systems of chemical kinetics equations. (RWR)

5636 (UCID—18857) NLTSS disc file service (prototype). Du Bois, P.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1980. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01.

Disc file service in NLTSS is provided by a process known as the FILE SERVER. The prototype NLTSS FILE SERVER will be part of the total NLTSS prototype operating system targeted for a CRAY-1 computer as a single-host system. It is the function of the server to create, manipulate, and destroy disc files. It must also maintain the catalog of all disc files. It is responsible for accomplishing logical disc I/O. Aspects described include the following: functionality, operations, sharing and access, and internal structure. (RWR)

5637 (Y/EN—474) Remote job entry system. Hensley, W.R. (Oak Ridge Y-12 Plant, TN (USA)). 11 Nov 1980. Contract W-7405-ENG-26. 27p. (CONF-801222—1). NTIS, PC A03/MF A01.

From MUSE International meeting; Fort Lauderdale, FL, USA (9 Dec 1980).

A computer network system is described which is being used by N.C. Engineering to access a batch processor for APT program processing. 1 figure.

5638 Optimal and heuristic solutions to the p-median problem. Rosing, K.E.; Hillsman, E.L.; Rosing-Vogelaar, H. (Univ. of Iowa, Iowa City). *USGeographical Analysis (U.S.);* **11**: No. 1, 86-89(Jan 1979).

The p-median problem is to find, for p facilities on a network, the locations that minimize the aggregate distance traveled from all nodes on the network, along the network, to their closest facility. The problem has been optimally solved by branch and bound, linear programing, and special decomposition algorithms. Problems of about fifty demand nodes seem to be the largest successfully solved by these optimal methods. A number of heuristics have been proposed for this problem because of the expense of optimal solutions for even small problems and the impossibility, at this time, of solving larger problems. The most commonly used heuristics appear to be those of Maranzana and Teitz and Bart. The results of a test of these two heuristics and a standard linear programing system on six test problems are reported. 1 table. (RWR)

5639 Pascal/P-code cross compiler for the LSI-11. Hitson, B.L. Contract EY-76-C-03-0515. Stanford, CA; Stanford Linear Accelerator Center (1979). 4p.

A description is given of the implementation of a cross compiler for Pascal that produces code that can be executed on an LSI-11 minicomputer. The approach taken is first to compile the source Pascal program (with an existing compiler) into an intermediate form known as P-Code. The P-Code is then cross compiled to LSI-11 assembly language. Once this has been achieved, the assembly language programs can be assembled with existing assemblers (such as MACRO-11) to produce relocatable load modules. These are linked together into an absolute load module and reformated for transmission via serial line to the LSI-11. The details of the implementation are described. A comparison is also made between the approach taken in this implementation (cross compiling to the host machine's assembly code) and the approach where P-Code is interpreted directly. 3 figures.

9903 Information Handling

5640 (CONF-801113—4) Developing a computerized text-management system: the ORNL experience. Mason, J.D. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From 4. annual practical conference on communications; Gatlinburg, TN, USA (7 Nov 1980).

The Technical Publications Department at Oak Ridge National Laboratory, as it nears the end of several years of planning and gathering equipment for a computerized text-management system, offers its experience to others planning similar systems, whether large or small. Although production experience is just beginning, it already has given considerable insight into how a system should be planned and what purchasers should look for in a system. Even though a high-speed third-generation phototypesetter is to be installed shortly, development is continuing; the system is to be extended to outlying offices, and even more advanced ways of integrating editing, composition, computer graphics, photography, and makeup into a unitary system are being sought. At the same time, users are being trained for the system as it will be used in the near future. The ultimate goal, however, remains to provide clients within the Laboratory with the best possible publications services at a reasonable cost, and to further the Laboratory's function as a center of energy research and development.

5641 (SAND—80-0851C) Making marketing work for you. Erickson, L.J. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 12p. NTIS, PC A02/MF A01.

An outline of the paper is presented, along with supporting slides that were used. A broad look at marketing of online services at a library or an information center that already uses online or is getting ready to use it is initially given. The similarities and differences among academic, special, and public libraries are summarized. Specific points to be addressed include: what is marketing; why should I market; what do I have to market; to whom should I market; how do I market; and what happens as a result of marketing. A promotional road show program is described.

5642 (UCID—18843) Feature analysis of relational concepts, languages and systems for NOMAD/sup TM/ and NOMAD2/sup TM/. Ries, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1980. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01.

NOMAD was developed to provide users of timesharing services with a data base management system. The system is independent of any particular class of systems, and is suitable for an extremely wide variety of applications. There are no inherent limitations on the total size of the applications except the machine limitations on the system on which NOMAD is running. Specifications are given with respect to data base constituents; functional capabilities; definition, generation and administration facilities; interfaces and DBMS architecture; operational aspects; and essentially relational solutions for generalized DBMS problems. Widespread use of NOMAD is sketched. (RWR)

5643 **(UCID—18844) Feature analysis of relational concepts, languages and systems for IDM/sup TM/.** Ries, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1980. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01.

The IDM (Intelligent Database Machine) is a self-contained system that serves as a dedicated peripheral providing a relational database management system. The IDM provides a high-level host-independent interface to OEM-supplied programs running on the host. Specifications of the system are given including database constituents; functional capabilities; definition, generation and administration facilities; interface and DBMS architecture; operational aspects; and essentially relational solutions for generalized DBMS problems. 1 figure. (RWR)

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Homogeneous chemistry of NO/sub x/ production and removal from fossil fuel combustion gases. Final technical report, 6:5124 (ARI-RR—235)
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Aerospace Corp., El Segundo, CA (USA)
Magnetospheric effects of ion and atom injections by the satellite power system, 6:4628 (ANL/EES-TM—94)

Alaska Univ., Fairbanks (USA). Geophysical Inst.
Report of the workshop on Arctic oil and gas recovery, 6:4513 (DOE/ET/14317—T3)

Alaska Univ., Fairbanks (USA). Mineral Industry Research Lab.
Characterization and evaluation of washability of Alaskan coals. Final technical report for Phase II, July 1, 1977-February 29, 1979, 6:4476 (DOE/ET/13350—T2)

Al-Azhar Univ., Cairo (Egypt)
SCALE system cross-section validation for criticality safety analysis, 6:4778 (CONF-801107—35)

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Physical and chemical characterization of borosilicate glasses containing Hanford high-level wastes, 6:4589 (RHO-SA—189)

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Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.
October 1980 environmental data for sites in the National Solar Data Network, 6:4626 (SOLAR/0010—80/10)

Avco-Everett Research Lab., Inc., Everett, MA (USA)
Optically pumped metal vapor lasers. Final technical report, 15 Apr 1978-15 Jul 1980, 6:5176 (DOE/DP/40008—1)

B

Babcock and Wilcox Co., Barberton, OH (USA). Fossil Power Generation Div.
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Qualifier
Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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AC01-79ET11268	**Skelly and Loy, Harrisburg, PA (USA)**	
	6:4493	FE—11268-1
AC01-79PE70143	**Energy and Environmental Analysis, Inc., Arlington, VA (USA)**	
	6:4939	DOE/PE/70143—02(Vol.2)
	6:4940	DOE/PE/70143—02(Vol.3)
AC01-80ET14317	**Alaska Univ., Fairbanks (USA). Geophysical Inst.**	
	6:4513	DOE/ET/14317—T3
AC01-80ET15602	**FluiDyne Engineering Corp., Minneapolis, MN (USA)**	
	6:4966	DOE/ET/15602—T2
AC02-76CH00016	**Brookhaven National Lab., Upton, NY (USA)**	
	6:4419	BNL—28577
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	6:5588	BNL—28480
AC02-76CH03000	**Fermi National Accelerator Lab., Batavia, IL (USA)**	
	6:5214	FERMILAB—80/11
AC02-76ER01198	**Illinois Univ., Urbana (USA). Materials Research Lab.**	
	6:5108	DOE/ER/01198—1327
AC02-76ER01338	**Michigan State Univ., East Lansing (USA). MSU/AEC Plant Research Lab.**	
	6:5285	DOE/ER/01338—1
AC02-76ER02232	**European Organization for Nuclear Research, Geneva (Switzerland)**	
	6:5532	DOE/ER/02232—92
	6:5533	DOE/ER/02232—94
AC02-76ER03023	**Tohoku Univ., Sendai (Japan)**	
	6:5530	CONF-800724—52
AC02-76ER03069	**Massachusetts Inst. of Tech., Cambridge (USA). Center for Theoretical Physics**	
	6:5541	CONF-8010138—2
AC02-76ER03077	**New York Univ., NY (USA). Courant Mathematics and Computing Lab.**	
	6:5626	DOE/ER/03077—168
AC02-76ET52040	**Illinois Univ., Urbana (USA). Fusion Studies Lab.**	
	6:5574	COO—2218-159
AC02-77CH00178	**Solar Energy Research Inst., Golden, CO (USA)**	
	6:4625	SERI/TR—743-396(Vol.1)
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	6:4688	SERI/PR—721-788
	6:4700	SERI/PR—731-931
AC02-77DP40047	**Physical Sciences, Inc., Woburn, MA (USA)**	
	6:5175	COO—4223-8
AC02-78ET11322	**Physical Sciences, Inc., Woburn, MA (USA)**	
	6:4967	DOE/ET/11322—T3
AC02-78ET20611	**Gilbert Associates, Inc., Reading, PA (USA)**	
	6:4636	DOE/ET/20611—14
AC02-78ET29345	**Gould, Inc., Rolling Meadows, IL (USA). Gould Labs.**	
	6:4901	DOE/ET/29345—21
AC02-78ET34212	**Babcock and Wilcox Co., Lynchburg, VA (USA)**	
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AC02-79ER10396	**Colorado Univ., Boulder (USA)**	
	6:5145	DOE/ER/10396—2
AC02-79ET23006	**Joint Center for Graduate Study, Richland, WA (USA)**	
	6:4637	DOE/ET/23006—4
AC02-79ET23007	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)**	
	6:4638	DOE/ET/23007—3

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AC02-79ET27225	**Brown Univ., Providence, RI (USA). Div. of Engineering**	
	6:4721	DOE/ET/27225—11
AC02-79ET34004	**Catalytic, Inc., Philadelphia, PA (USA)**	
	6:4868	DOE/ET/34004—1
AC02-79EV10092	**Mitre Corp., McLean, VA (USA). METREK Div.**	
	6:5323	DOE/EV/10092—1
AC02-80ER10583	**Minnesota Univ., Minneapolis (USA)**	
	6:5569	DOE/ER/10583—1
AC02-80ER10591	**Purdue Univ., Lafayette, IN (USA)**	
	6:5100	DOE/ER/10591—1
AC03-76ER00822	**California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials**	
	6:5052	CALT—822-101
AC03-76SF00515	**Stanford Linear Accelerator Center, CA (USA)**	
	6:4623	SLAC-PUB—2613
	6:5210	SLAC-PUB—2600
	6:5211	SLAC-PUB—2631
	6:5234	SLAC-PUB—2620
	6:5235	SLAC-PUB—2626
	6:5236	SLAC-PUB—2629
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	6:5632	SLAC-PUB—2633
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	6:5634	SLAC-TN—80-5
AC03-77ET10296	**Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group**	
	6:4454	DOE/ET/10296—66(Vol.1)
	6:4455	DOE/ET/10296—66(Vol.2)
AC03-77ET33006	**TRW Systems and Energy Group, Redondo Beach, CA (USA)**	
	6:4558	DOE/ET/33006—T1
	6:4599	DOE/ET/33006—T2
AC03-78CS40023	**Cyclomatic Industries, Inc., San Diego, CA (USA)**	
	6:5191	DOE/CS/40023—T1
AC03-78ET12086	**Mobil-GC Corp., Newport Beach, CA (USA)**	
	6:4512	DOE/ET/12086—1
AC03-78ET20535	**General Atomic Co., San Diego, CA (USA)**	
	6:4671	GA-A—15408(DRAFT)
AC03-78ET33009	**Teledyne Energy Systems, Timonium, MD (USA)**	
	6:4609	TES—2865-23
AC03-78SF01802	**Gary Operating Co., Englewood, CO (USA)**	
	6:4515	DOE/SF/01802—21
AC03-78SF02034	**United Engineers and Constructors, Inc., Philadelphia, PA (USA)**	
	6:4786	DOE/SF/02034—T6
AC03-79CS40213	**Beet Sugar Development Foundation, Fort Collins, CO (USA)**	
	6:4633	DOE/CS/40213—T1
AC03-79ET14842	**Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.**	
	6:4499	DOE/ET/14842—T4
AC04-76DP00053	**Mound Facility, Miamisburg, OH (USA)**	
	6:4579	MLM—2784
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AC04-76DP00487	**Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)**	
	6:5109	MHSMP—80-63
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AC04-76DP00613	**Bendix Corp., Kansas City, MO (USA)**	
	6:5157	BDX—613-2390
	6:5514	BDX—613-2531
AC04-76DP00656	**General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.**	
	6:5047	GEPP-TIS—540
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AC04-76DP00789	**Sandia National Labs., Albuquerque, NM (USA)**	
	6:4497	SAND—80-1920
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	6:4731	SAND—80-7159
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	6:5611	SAND—80-1493C
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	6:5641	SAND—80-0851C
AC04-76DP03533	**Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant**	
	6:4561	RFP—2864
	6:5250	RFP—3042
	6:5295	RFP—3118
AC04-77ET20260	**General Electric Co., Philadelphia, PA (USA). Space Div.**	
	6:4669	ALO—3985-1
AC04-78AL10752	**New Mexico Health and Environment Dept., Santa Fe (USA)**	
	6:4597	DOE/AL/10752—5
AC04-78CS15367	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Coll. of Engineering**	
	6:4693	DOE/CS/15367—T2
AC04-78CS34299	**Honeywell, Inc., Minneapolis, MN (USA). Systems and Research Center**	
	6:4694	DOE/CS/34299—T1
AC04-79ET27013	**H-Tech Labs., Inc., Santa Monica, CA (USA)**	
	6:4711	DOE/ET/27013—T1
AC04-76DP000789	**Varian Associates, Inc., Palo Alto, CA (USA)**	
	6:4654	SAND—80-7072
AC05-76OR00033	**Institute for Energy Analysis, Oak Ridge, TN (USA)**	
	6:4926	ORAU/IEA—80-11(P)
AC05-77ET20325	**Simplex Wire and Cable Co., Portsmouth, NH (USA)**	
	6:4675	DOE/ET/20325—T1
	6:4676	DOE/ET/20325—T2
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AC05-78ET13513	**Westinghouse Research and Development Center, Pittsburgh, PA (USA)**	
	6:5069	DOE/OR/13513—T1
AC05-78ET29305	**Commonwealth Associates, Inc., Jackson, MI (USA)**	
	6:4771	DOE/ET/29305—T1
AC05-79EV10299	**Dalton-Dalton-Newport, Cleveland, OH (USA)**	
	6:4557	DOE/EV/10299—T1
AC06-76ER01388	**Washington Univ., Seattle (USA). Nuclear Physics Lab.**	
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AC06-76RL01830	**RE/SPEC, Inc., Rapid City, SD (USA)**	
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	6:4736	DOE/RL/01830—T1
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	6:4881	PNL—3135
	6:4896	PNL—3429
	6:4897	PNL-SA—8998
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	6:4958	PNL—3404
	6:5111	PNL-SA—8975
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	6:5321	PNL—3403
	6:5468	PNL-SA—8679
	6:5609	PNL-SA—8527
AC06-77RL01030	**Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations**	
	6:4588	RHO-BWI-LD—24
	6:4589	RHO-SA—189
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AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
	6:4569	DOE/ID/05170—T1
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AC07-78CS40141	**California Univ., Davis (USA). Dept. of Agricultural Engineering**	
	6:5011	CONF-8006138—1
AC07-79ID01675	**Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)**	
	6:4568	CONF-801124—36
	6:4575	ENICO—1042
	6:5282	CONF-801038—17
AC07-80ID12115	**Fluor Engineers and Constructors, Inc., Irvine, CA (USA)**	
	6:4570	DOE/ID/12115—T1
AC07-80ID12183	**Engineering and Economics Research, Inc., Falls Church, VA (USA)**	
	6:4722	DOE/RA/12183—01
AC08-76NV01183	**EG and G, Inc., Santa Barbara, CA (USA). Energy Measurements Group**	
	6:5293	EGG—1183-1772
AC08-78DP40008	**Avco-Everett Research Lab., Inc., Everett, MA (USA)**	
	6:5176	DOE/DP/40008—1
AC08-78ET12150	**Mitchell Energy Corp., The Woodlands, TX (USA)**	
	6:4533	DOE/ET/12150—1
AC08-79DP40086	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.**	
	6:5618	WFPS-TME—80-014
AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	6:4571	DP-MS—80-47(Rev.)
	6:4572	DP-MS—80-96
	6:4573	DP-MS—80-112
	6:5114	DPSPU—80-30-7
AC11-76PN00014	**Bettis Atomic Power Lab., West Mifflin, PA (USA)**	
	6:4852	WAPD-TM—1457

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AC13-76GJ01664	**New Mexico Univ., Albuquerque (USA). Dept. of Geology**	
	6:4546	GJBX—215(80)
	6:4547	GJBX—238(80)(Pt.1)
	6:4548	GJBX—238(80)(Pt.2)
	6:4549	GJBX—238(80)(Pt.3)
	6:4550	GJBX—241(80)
	6:4551	GJBX—242(80)
	6:4552	GJBX—243(80)
	6:4554	GJBX—250(80)
	6:4555	GJBX—253(80)
	6:4556	GJQ—003(80)
AC13-767GJ01664	**Geodata International, Inc., Dallas, TX (USA)**	
	6:4553	GJBX—245(80)
AC14-76FF02170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
	6:4563	HEDL—6835
	6:4800	HEDL-SA—2125-FP
	6:4863	HEDL-SA—2211
	6:5070	HEDL-SA—2188
	6:5595	HEDL—6882
	6:5596	HEDL-SA—2197
AC21-76ET10377	**General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.**	
	6:4757	FE—2357-39(Vol.A)
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AC21-78ET15161	**Aerodyne Research, Inc., Bedford, MA (USA). Center for Chemical and Environmental Physics**	
	6:5124	ARI-RR—235
AC21-80MC14737	**Aerodyne Research, Inc., Bedford, MA (USA). Center for Chemical and Environmental Physics**	
	6:4481	ARI-RP—60
AC22-80PC30252	**Duquesne Univ., Pittsburgh, PA (USA). Dept. of Chemistry**	
	6:4457	DOE/PC/30252—T1
AI01-76ET12548	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	6:4490	DOE/ET/12548—1
AI01-77DP40042	**Naval Research Lab., Washington, DC (USA)**	
	6:5607	NRL-MR—4387
AI01-77ET13037	**Babcock and Wilcox Co., Barberton, OH (USA). Fossil Power Generation Div.**	
	6:4506	DOE/ET/13037—T1
AI01-78CS54209	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	6:5035	JPL-PUB—80-69
AI08-76DP00474	**Geological Survey, Denver, CO (USA)**	
	6:5502	USGS-OFR—80-1098
AI08-78ET44802	**Geological Survey, Denver, CO (USA)**	
	6:5300	USGS-OFR—80-942
	6:5493	USGS-OFR—80-569
AM01-77ET12532	**Ketron, Inc., Wayne, PA (USA)**	
	6:4492	FE—8915(10,12)
AM02-76CH03073	**Princeton Univ., NJ (USA). Plasma Physics Lab.**	
	6:5581	PPPL—1702(Rev.)
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	6:5584	PPPL—1727
	6:5610	PPPL—1723
AS01-76ET10623	**City Univ. of New York, NY (USA)**	
	6:4461	FE—2340-2A
AS01-77ET10505	**Brigham Young Univ., Provo, UT (USA)**	
	6:4462	FE—2729-11
AS02-76CS40202	**Arizona State Univ., Tempe (USA). Coll. of Engineering and Applied Sciences**	
	6:4616	COO—2982-57
AS02-76ER02422	**Rochester Univ., NY (USA)**	
	6:5066	COO—2422-28
AS02-76ER02853	**Massachusetts Univ., Amherst (USA). Dept. of Physics and Astronomy**	
	6:5543	DOE/ER/02853—15
AS02-76ER03283	**Johns Hopkins Univ., Baltimore, MD (USA). Hospital**	
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AS02-76ER13001	**State Univ. of New York, Albany (USA). Research Foundation**	
	6:5554	DOE/ER/13001—24
AS02-76ET33056	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry**	
	6:5146	DOE/ET/33056—15
AS02-76ET37241	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering**	
	6:4847	COO—2250-40
AS02-76ET53006	**Johns Hopkins Univ., Baltimore, MD (USA)**	
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AS02-76ET53051	**Wisconsin Univ., Madison (USA)**	
	6:5576	DOE/ET/53051—12
AS02-76EV02532	**Woods Hole Oceanographic Institution, MA (USA)**	
	6:5456	COO—2532-5
AS02-77CS34577	**Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.**	
	6:4635	DOE/ET/20279—95
AS02-78CS40153	**Pennsylvania Univ., Philadelphia (USA)**	
	6:5067	COO—4725-5
AS02-78ER04987	**Northwestern Univ., Evanston, IL (USA). Dept. of Chemical Engineering**	
	6:5126	DOE/ER/04987—1
AS02-78ET52048	**Wisconsin Univ., Madison (USA)**	
	6:5083	UWFDM—381
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AS02-78EV04733	**Columbia Univ., New York (USA). Radiological Research Lab.**	
	6:5414	COO—4733-3
AS02-80ER10566	**Massachusetts Univ., Amherst (USA). Dept. of Mechanical Engineering**	
	6:5570	DOE/ER/10566—1
AS04-78CS35405	**New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research**	
	6:4680	DOE/CS/35405—T1
AS05-76ER03992	**Texas Univ., Austin (USA). Dept. of Physics**	
	6:5571	DOE/ER/03992—427
AS05-76ER04837	**Oklahoma State Univ., Stillwater (USA)**	
	6:5099	DOE/ER/04837—7
AS05-76ER05056	**Howard Univ., Washington, DC (USA)**	
	6:5517	DOE/ER/05056—1
AS05-76ER05111	**Houston Univ., TX (USA). Dept. of Physics**	
	6:5068	DOE/ER/05111—3
AS05-76ET20312	**Oklahoma State Univ., Stillwater (USA)**	
	6:4972	CONF-800451—3
AS05-77ER05489	**Georgia Inst. of Tech., Atlanta (USA). School of Physics**	
	6:5566	DOE/ER/05489—T1
AS05-77EV05486	**University of South Florida, St. Petersburg (USA). Dept. of Marine Science**	
	6:5319	DOE/EV/05486—3
AS05-78ET20071	**Puerto Rico Univ., San Juan. Center for Energy and Environment Research**	
	6:4634	DOE/ET/20071—T3
AS05-78ET52025	**Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering**	
	6:5592	DOE/ET/52025—3
AS05-80ER10618	**Vanderbilt Univ., Nashville, TN (USA). Dept. of Computer Science**	
	6:5518	DOE/ER/10618—1
AS07-77ET28407	**Idaho Dept. of Water Resources, Boise (USA)**	
	6:4729	DOE/ET/28407—T1
AS08-76DP00269	**Washington Univ., Seattle (USA). Coll. of Fisheries**	
	6:5292	DOE/DP/00269—39
AS09-76EV00965	**Wake Forest Univ., Winston-Salem, NC (USA). Dept. of Biology**	
	6:5401	DOE/EV/00965—3
AS19-79BC20006	**Rice Univ., Houston, TX (USA)**	
	6:4511	DOE/BC/20006—18
AS21-77ET10533	**West Virginia Univ., Morgantown (USA). Coal Research Bureau**	
	6:4482	DOE/ET/10533—11
AS22-78ET03297	**Delaware Univ., Newark (USA). Dept. of Chemical Engineering**	
	6:4453	DOE/ET/03297—1
AT01-76ET10691	**Massachusetts Inst. of Tech., Cambridge (USA)**	
	6:4484	FE—2295-32-10
	6:4485	FE—2295-32-11
AT01-77ET29323	**National Engineering Lab. (NBS), Washington, DC (USA)**	
	6:4765	DOE/RA/29323—1
AT03-76ER70057	**Stanford Univ., CA (USA). Dept. of Materials Science and Engineering**	
	6:5082	SU-DMS—80-R2
AT03-76ER70224	**California Univ., Los Angeles (USA)**	
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	6:5496	DOE/ER/70224—T4
	6:5497	DOE/ER/70224—T5
AT03-76ET28502	**SRI International, Menlo Park, CA (USA)**	
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AT03-76ET35300	**General Atomic Co., San Diego, CA (USA)**	
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	6:4861	GA-A—16084
AT03-76ET35301	**General Atomic Co., San Diego, CA (USA)**	
	6:4789	GA-A—16057
AT03-76SF70030	**General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.**	
	6:4795	CRBRP-GEFR-SP—220
AT03-76SF70097	**SRI International, Menlo Park, CA (USA)**	
	6:4869	DOE/SF/70097—T2
AT03-76SF71023	**General Atomic Co., San Diego, CA (USA)**	
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CONF-800640-		(14. pulse power modulator symposium, Orlando, FL, USA, 3-5 Jun 1980)
19	6:5613	*See* UCRL-83998
CONF-8006102-		(Rockstore 80 conference, Stockholm, Sweden, 23-29 Jun 1980)
3	6:4564	*See* UCRL-85078
CONF-8006130-		(Advanced study institute on metal hydrides, Rhodes, Greece, 17-27 Jun 1980)
2	6:4614	*See* BNL-28584
CONF-8006137-		(Molecular structure and energy scrambling workshop, Bielfeld, F.R. Germany, 23 Jun 1980)
1	6:5522	*See* LA-UR-80-3252
CONF-8006138-		(Summer meeting of American Society of Agricultural Engineers, San Antonio, TX, USA, 15-18 Jun 1980)
1	6:5011	NTIS, PC A02/MF A01
CONF-8006139-		(Squid applications to geophysics workshop, Los Alamos, NM, USA, 2-4 Jun 1980)
1	6:4712	*See* LA-UR-80-3295
CONF-800714-		(NATO advanced study institute on fast reactions in energetic systems, Ioannina, Greece, 6-19 Jul 1980)
3	6:5567	*See* UCRL-84588
CONF-800724-		(20. international conference on high energy physics, Madison, WI, USA, 17-23 Jul 1980)
52	6:5530	NTIS, PC A02/MF A01
58(Summ.)	6:5532	*See* DOE/ER/02232-92
59	6:5533	*See* DOE/ER/02232-94
60	6:5536	*See* BNL-28630
CONF-800740-		(11. international conference on high energy accelerators, Geneva, Switzerland, 7-11 Jul 1980)
23	6:5228	*See* BNL-28035
CONF-800753-		(US DOE transuranic waste management program decontamination technology transfer meeting, Richalnd, WA, USA, 29-30 Jul 1980)
2	6:5295	*See* RFP-3118
CONF-800765-		(7. LLR/MMRD international symposium of interfaces in glass-metal systems, Berkeley, CA, USA, 28 Jul-1 Aug 1980)
4	6:5050	*See* LBL-11335
CONF-800766-		(5. international conference on hyperfine interactions, Berlin, F.R. Germany, 21-25 Jul 1980)
3	6:5549	*See* LA-UR-80-3279
CONF-800814-		(180. American Chemical Society meeting/2. chemical congress of the North American Continent, San Francisco, CA, USA, 24-29 Aug 1980)
P3	6:4471	25: No. 4, 19-28(1980)
P3	6:4472	25: No. 4, 95-102(1980)
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CONF-800872-		(International astronomical union colloquium 58 on stellar hydrodynamics, Los Alamos, NM, USA, Aug 1980)
8	6:5505	*See* LA-UR-80-2810
9	6:5508	*See* LA-UR-80-2816
11	6:5509	*See* LA-UR-80-2818
12	6:5510	*See* LA-UR-80-2871
14	6:5506	*See* LA-UR-80-2814
15	6:5507	*See* LA-UR-80-2815
17	6:5512	*See* LA-UR-80-3232
18	6:5511	*See* LA-UR-80-3231
CONF-800942-		(ANS topical meeting on 1980 advances in reactor physics and shielding, Sun Valley, ID, USA, 14-17 Sep 1980)
20	6:4800	*See* HEDL-SA-2125-FP
CONF-800950-		(11. symposium on fusion technology, Oxford, UK, 15-19 Sep 1980)
15	6:5588	*See* BNL-28480
16	6:5617	*See* UWFDM-380
CONF-800952-		(International conference on charged particle optics, Giessen, F.R. Germany, 8-12 Sep 1980)
3	6:5211	*See* SLAC-PUB-2631
CONF-800972-		(1980 Department of Energy passive and hybird solar energy program update meeting, Washington, DC, USA, 21-24 Sep 1980)
6	6:4684	*See* LA-UR-80-2930
CONF-800979-		(Workshop on nuclear data evaluation methods and procedures, Upton, NY, USA, 22-25 Sep 1980)
11	6:5553	*See* BNL-28451
CONF-800980-		(Applied superconductivity conference, Santa Fe, NM, USA, 29 Sep-2 Oct 1980)
32	6:5083	*See* UWFDM-381
CONF-800994-		(International symposium on H.E. physics with polarized beams and polarized targets, Lausanne, Switzerland, 25 Sep-1 Oct 1980)
7	6:5229	*See* BNL-28510
8	6:5210	*See* SLAC-PUB-2600

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CONF-8009118-		(12. summer school in nuclear physics, Mikotaki, Poland, 1-13 Sep 1980)
1	6:5556	*See* LBL-11436
CONF-801011-		(4. ANS topical meeting on the technology of controlled nuclear fusion, King of Prussia, PA, USA, 14-17 Oct 1980)
68	6:5616	*See* UWFDM-375
73	6:5609	*See* PNL-SA-8527
74	6:4604	*See* BNL-28627
75	6:5596	*See* HEDL-SA-2197
77	6:5618	*See* WFPS-TME-80-014
78	6:4606	*See* UCRL-84264
79	6:5589	NTIS, PC A02/MF A01
CONF-801036-		(Special topical meeting - materials performance in nuclear steam generators, St Petersburg Beach, FL, USA, 6-9 Oct 1980)
6	6:4795	*See* CRBRP-GEFR-SP-220
CONF-801038-		(16. DOE nuclear air cleaning conference, San Diego, CA, USA, 20-23 Oct 1980)
12	6:4576	*See* LA-UR-80-2864
17	6:5282	NTIS, PC A02/MF A01
18	6:4585	*See* PNL-SA-8521
19	6:4577	*See* LA-UR-80-3432
CONF-801039-		(20. annual Hanford Life Sciences symposium, Richland, WA, USA, 19-23 Oct 1980)
4	6:5279	*See* PNL-SA-8986
5	6:5468	*See* PNL-SA-8679
CONF-801068-		(2. international symposium on the production and neutralization of negative hydrogen ions and beams, Upton, NY, USA, 6 Oct 1980)
7	6:5218	*See* LA-UR-80-2841
9	6:5216	*See* LA-UR-80-2830
10	6:5217	*See* LA-UR-80-2831
CONF-801079-		(5. annual conference on materials for coal conversion and utilization, Gaithersburg, MD, USA, 6-8 Oct 1980)
	6:4421	NTIS, PC A17/MF A01
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CONF-801082-		(ORAU radiopharmaceutical dosimetry symposium, Oak Ridge, TN, USA, 6-10 Oct 1980)
4	6:5412	*See* BNL-28402
CONF-801088-		(National association of corrosion engineers, El Paso, TX, USA, 28-30 Oct 1980)
T(Rev.)	6:4571	*See* DP-MS-80-47(Rev.)
CONF-8010104-		(Western states section of the combustion institute fall 1980 meeting, Los Angeles, CA, USA, 20-21 Oct 1980)
3	6:5156	*See* SAND-80-8751
CONF-8010111-		(Symposium of Northeastern Accelerator personnel, Madison, WI, USA, 13-15 Oct 1980)
2	6:5213	*See* DOE/ER/01388-463
CONF-8010115-		(MARIA workshop on accelerator systems for relativistic heavy ions in medical and scientific research, Edmonton, Alberta, Canada, 20-24 Oct 1980)
1	6:5220	*See* LA-UR-80-3069
CONF-8010118-		(68. national safety congress and exposition, Chicago, IL, USA, 23 Oct 1980)
1	6:5322	NTIS, PC A03/MF A01
CONF-8010119-		(16. DOE nuclear cleaning conference, Boston, MA, USA, Oct 1980)
1	6:5160	*See* LA-UR-80-2847
CONF-8010120-		(IMOG machine tool subgroup meeting, Livermore, CA, USA, 7-8 Oct 1980)
1	6:5161	*See* SAND-80-2185C
2	6:5159	*See* LA-UR-80-2813
CONF-8010121-		(JANNAF propulsion systems hazards meeting, Monterey, CA, USA, 27-31 Oct 1980)
1	6:5246	*See* LA-UR-80-2854
CONF-8010122-		(Hanford maintenance conference, Richland, WA, USA, 1-2 Oct 1980)
1	6:4863	*See* HEDL-SA-2211
CONF-8010123-		(9. world dredging conference, Vancouver, Canada, 29-31 Oct 1980)
1	6:5314	*See* PNL-SA-8353
CONF-8010124-		(8. annual light water reactor safety meeting, Washington, DC, USA, 31 Oct 1980)
1	6:4851	*See* LA-UR-80-2858
CONF-8010126-		(Specialists workshop on fast pyrolysis of biomass, Copper Mountain, CO, USA, 20-22 Oct 1980)
1	6:4419	*See* BNL-28577
CONF-8010127-		(Neutrino mass mini-conference, Cable, WI, USA, 1-5 Oct 1980)
3	6:5547	*See* LA-UR-80-3368
4	6:5537	*See* BNL-28671
CONF-8010128-		(JOWOG 6 conference, Albuquerque, NM, USA, 7-9 Oct 1980)
1	6:5561	*See* LA-UR-80-3260
CONF-8010132-		(75th anniversary of the Illinois State Geological Survey symposium, Urbana, IL, USA, 9-10 Oct 1980)
1	6:4578	*See* LBL-11651
CONF-8010135-		(General Motors Research Laboratory conference, particulate carbon: atmospheric life cycle, Warren, MI, USA, 12-14 Oct 1980)
1	6:5131	*See* LBL-11678
2	6:5258	*See* LBL-11677
3	6:5033	*See* SAND-80-8663
CONF-8010136-		(MAECON '80 - a new decade in electronics, Kansas City, MO, USA, 14-15 Oct 1980)
1	6:5514	*See* BDX-613-2531
CONF-8010138-		(Symposium on perspectives on electro and photonuclear physics, Saclay, France, Oct 1980)
2	6:5541	NTIS, PC A02/MF A01

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CONF-801103-	(IEEE nuclear science symposium, Orlando, FL, USA, 5-7 Nov 1980)	
10	6:5232	*See* ORNL/TM-7556
15	6:5237	*See* SLAC-PUB-2635
16	6:5235	*See* SLAC-PUB-2626
18	6:5344	*See* LBL-11728
19	6:5627	*See* LBL-11018
20	6:5225	*See* LBL-11797
21	6:5598	*See* LA-UR-80-3186
22	6:4867	NTIS, PC A02/MF A01
25	6:5236	*See* SLAC-PUB-2629
26	6:5633	*See* SLAC-PUB-2640
27	6:5242	*See* BNL-28660
28	6:5212	*See* BNL-28613
32	6:5230	NTIS, PC A02/MF A01
33	6:5557	*See* BNL-28607
34	6:5632	*See* SLAC-PUB-2633
CONF-801104-	(73. annual meeting of the American Institute of Chemical Engineers, Chicago, IL, USA, 12-16 Nov 1980)	
6	6:4469	*See* UCRL-84610
10	6:5025	NTIS, PC A02/MF A01
CONF-801107-	(ANS international conference, Washington, DC, USA, 17-21 Nov 1980)	
28	6:5219	*See* LA-UR-80-2967
30	6:4777	NTIS, PC A02/MF A01
33	6:4849	NTIS, PC A02/MF A01
35	6:4778	NTIS, PC A02/MF A01
39	6:5550	NTIS, PC A02/MF A01
40	6:4566	NTIS, PC A03/MF A01
41	6:5614	*See* UCRL-84624
42	6:4794	NTIS, PC A02/MF A01
44	6:5317	NTIS, PC A02/MF A01
45	6:5114	*See* DPSPU-80-30-7
CONF-801111-	(6. conference on application of accelerators in research and industry, Denton, TX, USA, Nov 1980)	
6	6:5597	*See* LA-UR-80-2822
8	6:5177	*See* LA-UR-80-3187
9	6:5521	*See* LA-UR-80-3180
10	6:5222	*See* LA-UR-80-3140
13	6:5221	*See* LA-UR-80-3139
24	6:5590	NTIS, PC A02/MF A01
25	6:5515	NTIS, PC A02/MF A01
26	6:5227	*See* UCRL-84554
27	6:5516	NTIS, PC A02/MF A01
28	6:4602	*See* LA-UR-80-3365
29	6:5604	*See* LA-UR-80-3297
30	6:5573	NTIS, PC A02/MF A01
31	6:5611	*See* SAND-80-1493C
32	6:5223	*See* LA-UR-80-3220
33	6:5224	*See* LA-UR-80-3245
CONF-801113-	(4. annual practical conference on communications, Gatlinburg, TN, USA, 7-8 Nov 1980)	
4	6:5640	NTIS, PC A02/MF A01
5	6:5622	NTIS, PC A02/MF A01
CONF-801115-	(6. international symposium on packaging and transporting radioactive material, Berlin, F.R. Germany, 10 Nov 1980)	
22	6:4562	NTIS, PC A02/MF A01
CONF-801119-	(22. annual meeting of the division of plasma physics of the APS, San Diego, CA, USA, 10-14 Nov 1980)	
2	6:5615	*See* UCRL-84787
CONF-801124-	(3. annual meeting of the Materials Research Society, Boston, MA, USA, 17-20 Nov 1980)	
23	6:5081	*See* SAND-80-2610C
24	6:5103	*See* SAND-80-1283C
25	6:5195	*See* SAND-80-2679C
26	6:5111	*See* PNL-SA-8975
27	6:4567	NTIS, PC A02/MF A01
28	6:5080	*See* SAND-80-2606C
30(Draft)	6:5558	NTIS, PC A02/MF A01
32(Draft)	6:5559	NTIS, PC A02/MF A01
33	6:4586	*See* PNL-SA-8732
34	6:5065	NTIS, PC A02/MF A01
35	6:4589	*See* RHO-SA-189
36	6:4568	NTIS, PC A02/MF A01
CONF-801134-	(26. annual conference on magnetism and magnetic metals, Dallas, TX, USA, 11-14 Nov 1980)	
11	6:5051	*See* BNL-28632
CONF-801137-	(Workshop on energy policy analysis, Urbino, Italy, 3 Nov 1980)	
1	6:4906	*See* BNL-28412
CONF-801138-	(Electromagnetic guns and launchers conference, San Diego, CA, USA, 4-6 Nov 1980)	
6	6:5605	*See* LA-UR-80-3307
CONF-801139-	(Electro-optics/laser conference, Boston, MA, USA, 19-21 Nov 1980)	
1	6:5147	*See* LA-UR-80-2798
CONF-801145-	(Geological Society of America meeting, Atlanta, GA, USA, 17-20 Nov 1980)	
3	6:4573	*See* DP-MS-80-112
CONF-801148-	(ASTM conference on mechanical testing for deformation model development, Bal Harbour, FL, USA, 12-13 Nov 1980)	
2	6:5079	*See* SAND-80-1264C
3	6:5107	*See* SAND-80-1060C
CONF-801150-	(ACM Mountain Region conference, Denver, CO, USA, 15 Nov 1980)	
1	6:5193	*See* SAND-80-2336C
CONF-801152-	(Electric Power Research Institute workshop, Atlanta, GA, USA, 17-19 Nov 1980)	
1	6:4973	NTIS, PC A03/MF A01
CONF-801155-	(3. annual symposium on uranium mill tailings management, Ft Collins, CO, USA, 24-25 Nov 1980)	
1	6:4587	*See* PNL-SA-8861
CONF-801157-	(Annual aviation lighting seminar, Key West, FL, USA, 17-21 Nov 1980)	
1	6:4607	NTIS, PC A02/MF A01
CONF-801158-	(Interciencia workshop on materials for the future, Kingston, Jamaica, 17-21 Nov 1980)	
1	6:4920	NTIS, PC A02/MF A01
CONF-801201-	(3. international conference on lasers and applications, New Orleans, LA, USA, 15-19 Dec 1980)	
2	6:5128	*See* LA-UR-80-3377
CONF-801206-	(ORNL: conference on the leachability of radioactive solids, Gatinburg, TN, USA, 9-12 Dec 1980)	
3	6:4572	*See* DP-MS-80-96
CONF-801209-	(2. annual National Waste Terminal Storage (NWTS) information meeting, Columbus, OH, USA, 9-11 Dec 1980)	
3	6:4592	*See* SAND-80-2463C
CONF-801210-	(3. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 15-17 Dec 1980)	
3	6:4623	*See* SLAC-PUB-2613
6	6:4921	*See* LA-UR-80-3342
7	6:4646	*See* LA-UR-80-3387
8	6:4603	*See* BNL-28600
9	6:4605	*See* BNL-28679
CONF-801215-	(3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program, Los Alamos, NM, USA, 2-4 Dec 1980)	
2	6:5601	*See* LA-UR-80-3261
3	6:5602	*See* LA-UR-80-3262
4	6:5603	*See* LA-UR-80-3263
5	6:5586	*See* UCRL-85122
6	6:5579	*See* LA-UR-80-3238
7	6:5600	*See* LA-UR-80-3227
8	6:5599	*See* LA-UR-80-3214
CONF-801216-	(Conference on structure and properties of molecular glasses, New York, NY, USA, 8-10 Dec 1980)	
1	6:5108	*See* DOE/ER/01198-1327
CONF-801217-	(Symposium on modeling and low-level waste management, Denver, CO, USA, 1-4 Dec 1980)	
1	6:4595	*See* LA-UR-80-3366
CONF-801218-	(Colloque solaire international, Nice, France, 11-12 Dec 1980)	
1	6:4685	*See* LA-UR-80-3397
CONF-801220-	(ASTM symposium on extending aggregate resources, Orlando, FL, USA, 10 Dec 1980)	
1	6:5046	*See* BNL-28634
CONF-801222-	(MUSE International meeting, Fort Lauderdale, FL, USA, 9 Dec 1980)	
1	6:5637	*See* Y/EN-474
CONF-810101-	(American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) meeting, Chicago, IL, USA, 25-29 Jan 1981)	
1	6:4974	NTIS, PC A03/MF A01
2	6:4982	*See* LA-UR-80-2791
CONF-810102-	(1981 annual reliability and maintainability symposium, Philadelphia, PA, USA, 27-29 Jan 1981)	
1	6:4876	*See* LA-UR-80-2194
CONF-810306-	(5. symposium on turbulence, diffusion, and air pollution, Atlanta, GA, USA, 9-13 Mar 1981)	
4	6:5253	*See* UCRL-84546

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WAPD-TM-		
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9658	6:4872	*See* EPRI-NP-1382
WFPS-TME-		
80-014	6:5618	NTIS, PC A02/MF A01
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474	6:5637	NTIS, PC A03/MF A01

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